THE AMERICAN GAS LIGHT JOURNAL

PUBLISHING OFFICE No. 32 PINE STREET

DEVOTED TO THE INTERESTS OF ILLUMINATION, HEATING, MECHANICAL, CHEMICAL AND GENERAL SCIENCE.

VOLUME LXXIII.—No. 10. Whole No. 1,317. | NEW YORK, MONDAY, SEPTEMBER 3, 1900. | $3 PER ANNUM, IN ADVANCE.

A. M. CALLENDER & CO., Proprietors. C. E. SANDERSON, Manager. THOMAS J. CUNNINGHAM and ELBERT P. CALLENDER, Editors.

Published on each Monday of the year, at No. 32 Pine Street, New York.

Collections are invariably made directly from this office for subscriptions, advertisements, etc. We have agents to solicit the same, but they are not authorized to receipt for money.

Terms of Subscription, Including Postage.—For the United States and Canada, $3 per annum. European countries, $5 (£1—25 francs). All payments to be made in advance. Single copies, 10 cents.

Correspondence.—Wishing to make this JOURNAL a gazette of intelligent discussion to those of our readers who may wish to gain or give information on the subjects to which its columns are devoted, correspondence is solicited for publication from all who make the study of those subjects a pleasure or a profession.

Remittances should be made either by post office order, express money order, registered letter, or bank draft on New York, payable to the order of A. M. Callender & Co.

The American News Company, Nos. 39 and 41 Chambers street, New York, are agents for this JOURNAL. Newsdealers will send orders to them.

Books.—We will forward by express, at publisher's lowest rates, any book—scientific or otherwise—to any address in the United States or Canada. We would suggest to our patrons that to avoid the risk and expense consequent on sending us the money (we do not send books C. O. D.), that orders for books be sent us through the Purchasing Department of the American Express Company.

The Public Lighting Tables of the American Meter Company will be found in the page advertisement of that Company.

CONTENTS.

An Asterisk (*) denotes an illustrated article.

EDITORIALS—

Briefly Told 361

The Name of Whitney and the Artificial Lighting Business—Notes.

List of Papers to be Read at the International Gas Congress, Paris. 362

Eighth Annual Meeting, Pacific Coast Gas Association.—Official Report. Revised by the Secretary—Concluded from Page 331..... 362

Third Day, Final Session—Question Box—Votes of Thanks—Naming a Representative to the Next Meeting of the American Gas Light Association—Adjourned.

Some Curious Tests of the Air of a Room..... 365

Some Notes on Inquiries for Engines, by Mr. J. A. Seager 366

*The Design of Steam Power Plants. No. III. By Mr. H. C. Meyer, Jr 368

"Accidental" Impurities in Carbide of Calcium..... 371

*The Photometry of the Arc..... 371

ITEMS OF INTEREST FROM VARIOUS LOCALITIES..... 373

Death of Mr. A. B. Calef—No Gas Franchise, Dover, N. J.—The Clyde (N. Y.) Company Adjudged Bankrupt—Mr. W. D. West to Take Charge at Marion, O.—Price of Coke, Lowell, Mass.—A Hint from Portland, Me.—Gas Works for Oklahoma City, O. T.—Liberal Proposition by the Louisville, Co.—Mr. H. R. Marcott to Take Charge at Pekin, Ills.—Illness of Mr. C. H. Christie—Mr. H. J. McGowan Elected President, Kansas City, Mo.—Death of Mr. Wm. A. Duffield—And Other Items.

The Market for Gas Securities..... 374

ENTERED AT THE POST OFFICE AT NEW YORK, N. Y., AS SECOND-CLASS MATTER.

BRIEFLY TOLD.

THE NAME OF WHITNEY AND THE ARTIFICIAL LIGHTING BUSINESS.—The name of Whitney has been very much in evidence in the artificial lighting business of the United States during the last six years. In New York city we have heard of Mr. W. C. Whitney's connection with the supplying of electric currents for lighting and other purposes for about the length of time that marks his separation from his direction of the naval affairs of the country until he elected to again go into business on private account. The versatile gentleman also has had a *trifle* to say about gas matters in the borough of Manhattan. Luckily for himself, having found that one cannot profitably serve two masters for long time, he eventually cast his dual lighting lot with the people who have successfully controlled the gas supply of New York city for quite a number of years. So much for Whitney the First as a factor in the artificial lighting industry of these parts. The second Whitney, who sought fame and shekels in the artificial lighting field of this section, selected the vicinity of Boston as his particular meadow. Henry M. Whitney is the way he signs himself, and he elected to make coke, tar and ammonia as his staples, the gas from his coke ovens to be used as a bye-product, with the understanding though that it was to be sold to the legitimate gas companies of the Boston section at a price which would enable them to make great profits; but failing which purchase on their part it was to be distributed by Mr. Whitney's Company to every consumer that would take it at a price that would speedily put the Whitney Company's opponents out of business. So far, judging from the achievements of Mr. Whitney's plant at Everett, out of which gas has been going for the recognized parturition period, it seems that while that plant was planned for certain requirements, many changes have been found necessary in its construction and operation to enable it to even go on putting out satisfactory articles of coke and tar. Meanwhile most of the Boston district legitimate gas companies are doing business on pretty much the same lines that they followed before Mr. Henry M. Whitney knew much about gas making. In time, we hope he will become better acquainted with how gas is made and sold for profit, although in the interim we presume those who put money in his coke-tar-ammonia-gas enterprise will be waiting for sensible returns in the shape of dividends. So much for Whitney the Second. Mr. C. Henry Whitney, also of Boston, may be written down as the Third. He is now exploiting, in the vicinity of the Capital City of the State of Massachusetts, a process invented by a resident of Somerville, Mass., which, according to the Worcester *Telegram*, as described therein by Mr. Whitney, is about like this: "How to burn air at the small price of nothing per cubic foot, and make it give a light which is stronger and more brilliant than an electric arc light, is what one inventor 'down our way' has done. * * * By mixing a portion of the atmosphere with common illuminating gas the secret of making air give a clear light suitable for illuminating purposes has been solved." Of course, "we" have organized a company, etc. Again, "Common air will burn readily when it is ignited. When a fire is started in a stove, it is not the shavings nor the oil nor the wood which burns so brightly; it is the oxygen which is in the air." But why go further with quotations from the speech of Whitney the Third? Surely what has been reprinted is sufficient proof that his knowledge of the manufacture, dis-

tribution and use of gas is about equal to that held by the Whitneys, Nos. I. and II.

NOTES.—Last June the authorities of the University of Harriman, Tenn., conferred upon Mr. J. T. Westcott, M.E., Manager of the Economical Gas Apparatus Construction Company, of Toronto, Can., the degree of Doctor of Philosophy. This distinction was obtained for merit, or scholastic qualification, rather than on honorary account.——The Western Gas Construction Company is under contract to construct a complete coal gas works at Defiance, O.——Write to Henry Maurer & Son, 420 East 23d street, New York, for a copy of their well put together pamphlet describing their latest fireproof construction, known to the trade as the "Herculean" Floor Arch.——Mr. Thomas Baumgardner, of Williamsport, Pa., has been appointed Superintendent of the Columbia (Pa.) Gas Company, vice Mr. Robert Beacham, deceased.

List of Papers to be Read at the International Gas Congress, Paris.

The *Journal of Gas Lighting* last to hand was enabled to give a complete list of the papers to be read at the forthcoming International Gas Congress. The names of the authors and the titles of their communications appear in the order of the programme of questions proposed some time back for discussion. Some of these papers have already been printed for circulation among those who intend to be present at the Congress, while the other communications, not received in time, will only appear after the meetings have been held. The list is as follows:

"Inclined Retorts." By Mr. C. E. Brackenbury, of London.

"Mechanical Means of Dealing with Coke in the Works of the Paris Gas Company." Report by M. Louvel, of the Paris Gas Company.

"Coal Handling Plant." By Mr. F. D. Marshall, of Copenhagen.

"Notes on a Retort Bench with Independent Producers at a Distance." By M. G. Eichelbrenner, of Paris.

"On the Measurement of High Temperatures." By Mr. Alten S. Miller, of New York.

"Thermic Reactions during the Carbonization of Coal. Registering of High Temperatures. Details of Experiments." Report by M. Euchène, of the Paris Gas Company.

"On the Absorption of Hydrocyanic Acid by Illuminating Gas, as an Introduction to the Question: What Progress has been made in the Manufacture of Gas in Respect of the Production, by Liquid Process, of Yellow Prussiate of Potassium?" By Dr. A. Smits, of Amsterdam.

"Production and Manufacture of Cyanides in Gas Works." By Dr. J. Bueb, of Dessau.

"Carburetted Water Gas: Its Use in Coal Gas Works." By M. Henri Sospizio, of Trieste.

"Means to be Adopted for Avoiding Naphthaline Obstructions." By Dr. J. Bueb.

"In What Way the Normal Loss of Gas in Distribution may be Reduced to the Greatest Extent." By Mr. P. H. Gibbons, of Philadelphia.

"Gas Engines and Their Gas Supply." By M. Aimé Witz, of Lille.

"Reduction in the Cost of Distribution by the Adoption of High Pressures." By Mr. F. H. Shelton, of Philadelphia.

"Concerning Consumers' Meters." Opening of a Discussion on Wet and Dry Meters. By M. Bigeard, of Angers.

"Advantages and Disadvantages of Dry Meters." By M. G. Asselburgs, of Bergen-op Zoom.

"Results obtained in Holland with Prepayment Meters." By M. P. Bolsius, of Bois le-Duc.

"Report on the Utility of Standardizing the Pitch of Screws for Gas Fittings." By M. J. Bengel, of Paris.

"The Photometry of Incandescent Gas." By Dr. H. Bunte, of Carlsruhe.

"Draft of Conditions and Rules to be Observed in the Photometry of Incandescent Gas Mantles." By MM. Stœcklin, Rieder, and Co., of Mulhouse.

"Heating and Cooking by Gas." Report by M. A. Lévy, of the Paris Gas Company.

"Statistics of Swiss Gas Works. Diagrams and Plans of the Gas Consumption and Town of Zurich, 1890-1899. Plan of the Gas Works of Winterthur and Geneva." By La Société Technique Suisse, des Directeurs de Gaz et Eaux.

"Notes on the Public Lighting Arrangements of Guayaquil." By M. Charles Guichard, of Paris.

"Comparison B-tween the Usual Illuminants by Means of Diagrams." By M. Ad. Bouvier, of Lyons.

"Automatic Lighting and Extinguishing of Gas in High Street Lamps." By M. F. Koenig, of Berlin.

"Examination of the Competitive Illuminants of Gas." By M. A. Lecomte, of Paris.

"La Lumière Globe." By M. Ernst Salzenberg, of Crefeld.

"Means of Interesting Stokers in Retort House Work." By M. I. Hedde, of Paris.

"The History, Character, and Results of the Educational Fund Instituted by the American Gas Light Association for the Technical Instruction of Gas Workers." By Mr. Alfred E. Forstall, of New York.

[OFFICIAL REPORT.—REVISED BY THE SECRETARY.—CONCLUDED FROM PAGE 331.]

EIGHTH ANNUAL MEETING, PACIFIC COAST GAS ASSOCIATION.

HELD IN SAN FRANCISCO, CAL., JULY 10, 11 AND 12, 1900.

THIRD DAY, JULY 12TH—FINAL SESSION.

The final session of the meeting was held, pursuant to adjournment, the morning of July 12th, at the summit of Mount Tamalpais, one of the open cars of the Mill Valley and Mt. Tamalpais Scenic Railway serving as the meeting room.

The President, in announcing the regular order, said: We adjourned yesterday afternoon for the purpose of continuing our session to final adjournment, at something over 2,500 feet above the level of the sea. The first business in order is the discussion of the contents of the

QUESTION BOX.

The first question is:

"Has any member had experience with the use of gaseous fuel for hot water radiators, and with what success?"

Mr. Britton—During the whole of last winter we heated our office with a hot water circulating system, using gas under the furnace in place of coal as theretofore. I could not recommend it to our patrons. It was a success as far as heat was concerned, but not in the matter of making out the bill. We used two oven burners from a Detroit Jewel stove which effectively kept the water at the temperature necessary for heating the office. The room was about 32 feet by 80 feet, fitted with four 6 tube radiators. The cost was 50 cents per day, based on gas at $1.25 per 1,000, which would be prohibitive for general use.

Mr. Foveaux—We have had a like experience, in experimenting with a hot water heater for a house in San Francisco. The owner insisted upon having gas for heating, but in the end he found it too expensive and we took the burner out. It cost about $4.50 per day, the consumption of gas being about 360 feet per hour to keep the heat up, and the heat was well kept up. Of course we knew what result would be before we tried it, but we carried out the experiment for the sake of showing we were right in claiming that gas was not an economical fuel when used in that way.

Mr. Britton—In the matter of the use of gas for furnaces, you may remember that last year I called your attention to the fact that I was selling gas to a firm in Oakland, for the purpose of generating steam under an ordinary upright, tubular boiler, and that the service had been an entire success. With a certain consumption of gas per hour I was enabled to maintain a pressure of 40 pounds of steam, and that the cost had been satisfactory as compared with the previous cost of coal. I know that I was given the "ha! ha!!" by a good many of the members who thought I was "talking through my hat" and not keeping strictly to the truth. Fortunately enough Mr. Grimwood was at my office about a week ago. I took him to the place, showed him what was there, and left him to ask questions of the person in charge. He also saw the bills paid for the service, and I would like him to tell you what he found we were doing with gas.

Mr. Grimwood—Last year when Mr. Britton spoke of the matter I do not think anyone laughed more than I did at his statement, and I made up my mind, being a resident of Oakland, that I would visit the place and see what was being done. I did not see how it was possible to carry 40 pounds of steam, use the steam, and do it economically. Time went on and I did not get over there until a week or so ago, when Mr. Britton offered to take me around to the place, show me the boiler, and allow me to ask any questions I pleased; in fact, investigate the thing as thoroughly as I desired. I found an ordinary, 10-horse power upright boiler, about 6 feet high and 2½ feet in diameter, with a woman in charge. Instead of 40 pounds of steam I found they were carrying 80 pounds. The woman told me she could get up steam in the morning in about 20 minutes, then she shuts off one burner entirely and maintains the 80 pounds with a single burner. With this 80 pounds of steam they run their mangle, which is an affair of considerable size, and also a drying box heated by steam coils. In addition to this they heated the store last winter. The woman in charge said that they had not the slightest difficulty in maintaining 80 pounds with one burner. The bills showed an average of 1,500 feet per day, the plant being operated constantly during working hours. Mr. Keller finds that it is a great deal more economical than using coal. Installed as it was, it was difficult for me to examine the apparatus thoroughly. They have a 1¼-inch supply, and the burner is a circular affair that fills the whole bottom of

the place underneath the boiler. The 1¼ inch pipe supplies each of the halves separately, so that when they get up their pressure they can run on one. The burner is of the Bunsen type. It takes in air down near the cock outside the shell of the boiler. The pipe runs in horizontally with an elbow extending upwards about 14 or 18 inches. They claim they can get up steam in 20 minutes, using the water that is in the boiler over night, which is not at a very high temperature. Just at the outlet from the boiler, below the stack proper, is a coil through which the water passes and is heated by the waste gases. Mr. Britton tells me this was an after thought, that they did not have it at first. It is a very great improvement.

Mr. Britton—They simply utilize the stack gases. The temperature of the water, after passing through this coil heated by the stack gases, is 185°, at which temperature it is fed into the boiler proper. The stack of the boiler is an ordinary stack. At the top of the boiler I put in 100 feet of ordinary ¼-inch wrought iron pipe. The feed water to the boiler passes through that.

Mr. Lowe—Does not that collect lampblack?

Mr. Britton—When they first started the flue stopped up with soot, because the combustion was not properly arranged; but since this woman has been in charge there has been no difficulty.

Mr. Lowe—If your boiler is economical, why should not hot water radiators run by gas be economical too?

Mr. Britton—I think they would be if hot water furnaces could be built on lines adapted to gas. I doubt if the burner I employ for this purpose would be. It is a casting with about 340 burners, 170 in each segment. The combustion chamber is about 3½ inches deep.

Mr. Lowe—It is known that hot water heating is more economical than steam. It would seem that it is simply a question of the proper application of gas to the heater.

Mr. Britton—I should add that when they were heating the building the steam dropped down to 60 pounds. They could hold it at that point however.

Mr. Aldrich—Is a great deal of steam actually used?

Mr. Britton—Very little steam is used, although in the mangler, and for the starching machine also, a good proportion of the steam is actually used. The steam in the drying chamber is merely circulating.

Mr. Aldrich—What size is the engine?

Mr. Britton—The only engine used is the one operating the mangler. It is possibly 1-horse power.

Mr. Joslyn—What fuel were they using before?

Mr. Britton—Wellington screenings, at $8 per ton.

Mr. Lowe—As a matter of fact they could run it cheaper with oil.

Mr. Britton—Yes, except for the danger and inconvenience. As a matter of safety more than anything else gas was used.

Mr. Foveaux—How is it possible that gas can be more economical than coal? We know it takes three times more gas to give the same number of heat units.

Mr. Britton—Because gas can be applied with economy and used only when needed. Gas is more economical because of its elasticity.

Mr. Valentine—Is the maximum steam pressure needed all the time?

Mr. Britton—They do not require the maximum pressure of the steam continually. Perhaps if they required 80 pounds all the time, and a great deal of it, it would not be economical.

Mr. Grimwood—No matter how much you discuss the question the fact remains that the man who pays the bills is more than satisfied, and that the woman who has charge of it would not give it up for coal or anything else.

Mr. Osborn—I am interested in water heating for steam fire department boilers. I tried it in Marysville, and see quite a field if we could successfully heat the water in the boilers. I succeeded in keeping up 190° on a consumption of 20,000 feet per month, but it did not quite fill the bill. I would like to know if anyone else has had any experience. It would be a great convenience to the fire department. Has anyone succeeded in giving them what they want? They are willing to pay a trifle higher price for gas than for coal, if it could be applied successfully. We tried a "Reliable" waterback heater, a "Douglass" and a "Jewel."

Mr. Lowe—Have you ever corresponded with any other fire departments?

Mr. Osborn—No, sir.

Mr. Adams—We are running two steamers in Stockton and supply them with natural gas at $1 per 1,000.

Mr. Britton—If you will come to Oakland you can see fire engines equipped with a heater which raises the water to about 210°.

Question No. 2: "Does the gas engine business get the attention it deserves, particularly for small power users?"

The President—The Chair is of the opinion that the simple answer to the question is, "No."

Mr. Casey—I believe one very important feature in the gas business which has been overlooked is the matter of furnishing compressed gas for running gas engines in isolated plants. The Standard Oil Company sends gasoline to every market in cars and in tanks. There is no reason why you cannot compress gas more cheaply, and a tank of it will last longer. While at Philadelphia, starting our business some years ago, we had an engine made where there was no gas company and had to get our gas in tanks. They sent us tanks of gas compressed to 700 or 800 pounds to the square inch; a regulator was applied to the end of the tank. There is no reason why gas companies should not have that business. Gasoline engines are used all over the country, and an ordinary small gas engine is worth 100 stoves in point of consumption.

Mr. Lowe—Could a gas engine be so constructed as to take advantage of high pressure contained in gas to partially drive the engine?

Mr. Casey—By using a 2-cylinder engine that might be done, but it has not been a success. The 4 cylinder engine does not admit of that, but by the use of compressed gas and a regulator the same effect is secured that would be gained by taking the gas direct from the city mains.

Mr. Jones—It is a deplorable fact that gas companies have been neglecting gas engines. They say, "Why don't you use a gas engine?" The other fellows say, "Well, why don't you?" The electric people are discovering the value and efficiency of the gas engine. They taught us that the Welsbach light is the greatest competitor of electricity, and they are constantly teaching us what we have that is good.

Question No. 3: "Where do most naphthaline stoppages occur?"

The President—At the most unexpected places.

Question No. 4: "Would it be feasible to place some sort of device on services for the arrest and detention of naphthaline?"

Answer—"No."

Question No. 5: "Has any member had practical experience with any solvent for naphthaline other than gasoline?"

Mr. Jones—Hot water is the cheapest and best solvent, if it is available.

Mr. Lowe—Gasoline is not a solvent. Its use is valuable, but for another reason. I believe Mr. Jones has been preparing some data on this subject.

Mr. Jones—They cover a month of experiments. I may say now that the use of gasoline tends to hold the naphthaline in suspension and deliver it to the consumer, so that it adds to the luminosity of the flame without the cause being known. We only know that it leaves the gas. Regarding the use of hot water I find that in gas works the men are afraid to use enough water. They put a little water into the inlet and expect it to heat up an immense quantity of cold pipe in a few minutes. At our works we take time to flush the pipes with hot water. We fill them right up, and then use a little deep-well steam pump with an ordinary steam hose connection to pump the water out again. It would pay moderately large companies to apply this method to their holder drips.

Mr. Lowe—I move that Mr. Jones be requested to prepare a paper on this subject for the next meeting of the Association. This is a very important subject, and we would enjoy a paper on it very much, and Mr. Jones is just the one to write it. (Seconded and adopted.)

Mr. Britton—Mr. Beck, of the Oakland Company, who is here, has had a great deal of experience in this direction. From our water gas plant to our secondary scrubber, and then to the purifiers, is a distance of about 1,000 feet, through a 16-inch pipe that is continually filling up. Mr. Beck might throw some light on his method.

Mr. Beck—The 16-inch pipe often becomes filled with naphthaline its entire length. We connect a 2 inch steam pipe from a boiler to the end of the pipe at the works and open the other end of the pipe next to the scrubber 1,000 feet away. It takes from 3 to 6 hours to get it started, but when the naphthaline begins to flow it comes out the full size of the pipe in liquid form leaving the pipe perfectly clean. You could open the pipe and not find a portion of naphthaline. As soon as it strikes the ground it becomes about as hard as tallow.

Mr. Parker—Are you bothered with leakages after having such a heat?

Mr. Beck—No; not in the least.

Mr. Aldrich—I would like to know the reason for the absence of naphthaline from our works and services. I assure you that in Spokane

we do not find the slightest sign of naphthaline at the purifiers or in the services.

Mr. Jones—We have only known naphthaline since we have been making gas of high candle power. Probably it is the poor quality of gas you are making. (Laughter.)

Mr. Lowe—A very interesting and comprehensive paper on this subject has recently been published in the *Journal of Gas Lighting*. Those of you who are interested in the subject can do nothing better than to get hold of that article.

Mr. Aldrich—I want to say that Mr. Jones's implication is incorrect. The London gas companies for instance were in existence before the San Francisco Company was born, and naphthaline was the bane of the London Companies for many years.

Question No. 6: "Is the luminous flame of a gas jet as hot as the blue flame of a gas stove burner, per unit volume of gas burned?"

Answer—Yes.

Question No. 7: "What is being done with residual oil tar?"

Answer—Roofs are painted with it, and many other uses are found for it.

Question No. 8: "Has any member used McKittrick oil in water gas making, and with what results?"

Mr. Britton—We have had no experience with that oil alone. I bought a quantity of it, varying from 18° to 22° gravity, but used separately I could see no difference in the results.

Mr. Lowe—Was there any difference in price?

Mr. Britton—I succeeded in getting it at a little lower price because I relieved the oil man of some cars he had on hand. They won't sell it cheaper now. I believe they are asking more.

Mr. Lowe—What is the current rate of Coalinga oil?

Mr. Britton—I believe they are asking $1.40 per barrel at Coalinga.

Question No. 9: "What has been the experience with street lighting by Welsbach burners?"

Mr. Jones—I put in that question, because at the time I wrote the question I was extremely interested, as I am now, in the matter of lighting San Francisco with Welsbach burners. I was looking for light. I wanted to find out the experiences of the members.

Mr. Parker—Napa is lighted with Welsbach burners in opposition to electric lights. We have streets lighted by Welsbachs, 300 feet apart, and the streets so lighted are frequented by the people in preference to streets lighted by arcs.

Mr. Aldrich—How far are the arcs apart?

Mr. Parker—600 feet.

Mr. Lowe—Were the Welsbachs cheaper than the arcs?

Mr. Parker—Yes, cheaper and more satisfactory. The arcs were lighted only until 1 o'clock, while the Welsbachs burn all night.

Mr. Lowe—Was the service performed at a loss to the gas company?

Mr. Parker—No.

Mr. Joslyn—How many mantles were required per year for each lamp?

Mr. Parker—They averaged about four or five a year.

Mr. Joslyn—Did you place a meter on your street lamps?

Mr. Parker—No.

Question No. 10: "What is the experience of the different gas companies throughout California and the Pacific Coast in the use of the different kinds of anthracite coal supplied from Wales, Pennsylvania, Colorado and New Mexico? As the supply is frequently interrupted from all these sources it might be well to ascertain what basis of equivalents exists as to their values for our purposes?"

The President—It seems to the Chair that this would make the foundation for an excellent paper to be read at the next meeting.

Mr. Lowe—The trouble is that the conditions change daily. To-day you can scarcely get hard coal of any kind on the Coast.

Mr. Britton—Perhaps I might give my experience. I think our Company was the pioneer in the matter of the use of Welsh anthracite coal. Some years ago when the supply of Welsh diminished we were induced to try the Colorado, which was brought here at a cost of $11.50 a long ton. That did not prove satisfactory, on account of the large amount of iron and sulphur contained. It was a poor water gas coal. We abandoned its use. Latterly we have been using, with a good deal of success, the Cerillos coal from New Mexico. It is closely allied in its appearance to the Pennsylvania, approaching the Lehigh. We get it for about $11 a long ton, delivered in Oakland. It is a good, clear, hard coal with no waste whatever. It burns freely and does not seem to possess any iron. We do not use any more per 1,000 feet than of Welsh, with the added advantage of having no loss. The ordinary losses on Welsh anthracite coal will run from 30 to 50 per cent. in screenings, which may or may not be available for boiler fuel or for sale. When you take that loss into consideration it brings the cost of the ordinary Welsh coal fully up to that of the Cerillos. On the other hand you have the disadvantage of not being able to get the Mexican coal when you want it. We contracted for a certain quantity to be delivered each month, but were informed that the mine had shut down and would not re-open until fall. It has been for the last three years shutting down in the summer for four or five months. I recommended the coal to Mr. Osborn, and he has had some experience with it in small generators. It is certainly a good coal, and, as I said, its value is increased by the fact that there is practically no loss. Out of 500 tons I did not lose 1½ tons in screenings.

Dr. Powers—I want to add my testimony to that of Mr. Britton in favor of the Cerillos anthracite. In the paper I read to the Association I tried to explain its relative value. We have tried the Colorado. It is a very good quality of coal, but it will not make gas. Welsh anthracite we have never made a thorough test of, but I know from experience the amount of loss there is in its use. I believe Cerillos is the best coal a gas man can get, providing he can get it at a corresponding figure. He can afford to pay more. The waste is small and the amount of gas produced is relatively greater than in the case of the other coals. As Mr. Britton says, the mines shut down, but when they are running you can make contracts for the year, and I would advise those who are in the market for anthracite coal to examine the properties of the Cerillos before they make contracts in any other direction.

Mr. Osborn—I have used during the past month Cerillos, Welsh anthracite and Colorado coal. At the beginning of the month I used Welsh anthracite, which cost about $14 per ton at Marysville. I should on a run make 1,100 feet, but with Welsh anthracite it was between 900 to 1,000. With clinkering the loss is double that of either the Cerillos or the Colorado. Later a car of Cerillos arrived and I got up to 1,100 feet per run. With Welsh anthracite down came my yield. With the Colorado anthracite we are now running 1,000 feet per run, but find we have to watch our purifiers in using the coal.

Mr. Lowe—Do you use the same amount of steam with the Cerillos as with the Welsh? What becomes of the excess steam?

Mr. Osborn—It throws down somewhere.

Mr. Lowe—It does not condense?

Mr. Osborn—No, we do not get anything in the holder.

Mr. Pederson—I think the excess of steam in using Welsh anthracite passes up either between the lining and the coal or in some low spot in the fire. If we could drive the steam through the Welsh as we do through the Cerillos we would be able to make fully as much gas, but it has the quality of packing. In a weak spot the steam goes up, the balance passes off as steam and condenses in the purifying apparatus.

Mr. Britton—The Cerillos coal has one peculiarity. Neither the fire nor the blasting affects it. The coal comes out of the fire in exactly the same shape that it goes in. It requires a little longer blasting to make it more effective than the Welsh coal.

Mr. Lowe—Did you get as good results with the one as with the other?

Mr. Britton—I think our conditions are different from Mr. Osborn's. We have a very much larger set. You cannot compare a 3-ft. 6-inch set with a 9 ft. set. I do not think there was any variation in the amount of coal used per 1,000. I think we used the same number of pounds in both cases.

Votes of Thanks.

The President—Before we adjourn I want to say to you that I thank you very much for your kind indulgence during this session. I hope that you have extended to me a disposition of charity when I may have seemed to be a little arbitrary, but you know that in a body of men like this it is necessary sometimes to call a little attention to the subject that is before us. I hope I have not offended anyone in what may have seemed to be an arbitrary ruling. I now take pleasure in turning over this gavel to Mr. Britton. I am placing it in hands that will guarantee to you a successful meeting, equalling, if not surpassing, any the Pacific Coast Gas Association has ever held.

Mr. Aldrich—Before we adjourn I move we continue the Wrinkle and Experience departments for the next year with the same editors. I do not think these departments have received the attention they should, and that for this reason we cannot pay these gentlemen any lesser compliment than to appoint them for the ensuing year. [Carried.]

Mr. Jones—I move that the Association offer to its outgoing President and Secretary and the Editors of the Wrinkle and Experience

departments a hearty vote of thanks for their labors. I think this meeting has been the most successful in our history. Certainly the shell has been full of meat. [Carried.]

On motion of Mr. Collins a vote of thanks was passed to the Committee of Arrangements and the other hosts who had been so unremitting and successful in their efforts to entertain the Association and its guests.

NAMING A REPRESENTATIVE TO THE NEXT MEETING OF THE AMERICAN GAS LIGHT ASSOCIATION.

Mr. Britton—I think the Association should take steps to have a representative present at the meeting of the American Gas Light Association, at Denver, next October. They are coming so near we should take this opportunity. One man in our Association who, more than any other, would be welcomed in the arms of the Eastern gas men. The remarks I heard about him at the meeting of the Western Gas Association were of such a character as to make any man proud. I refer to Mr. Edward C. Jones. They are hungry to see "Ed." Jones back there; their hearts are aching to take him in. I move, you, that Mr. Edward C. Jones be appointed a committee of one to represent the Pacific Coast Gas Association, and that this Association request of the San Francisco Gas and Electric Company that Mr. Jones be sent there as the representative of the Association. [Carried.]

The convention was then declared adjourned.

Some Curious Tests of the Air of a Room.[1]

Mr. Francis Jones, Chemistry Master in the Manchester Grammar School, has recently forwarded to us a pamphlet entitled "The Air of Rooms;" being an account of the results of an examination, made by himself, into "the effect produced on the air of rooms by the use of gas, coal, electric light, etc., for heating and lighting purposes." Our attention had previously been attracted to this research by a notice appearing in the *Manchester Guardian*, which gave the cheerful intelligence that, according to Mr. Jones, the use of gas for heating or lighting "should be eschewed, so far as is possible, by all who wish to live in reasonably pure air." The newspaper went on to furnish some particulars of the dreadful results ascertained by Mr. Jones to be produced by the burning of gas in "rooms;" and we were naturally interested to learn whether these were applied only to the burning of Manchester gas in its native air, or whether the consequences might be regarded as of general application. Accordingly, we have studied the original source of this information with an intensity of interest that almost deserves to be called morbid; for the *Journal*, as its regular readers know, has given more attention to the study of aerial sanitation than almost any other technical periodical in English. We have followed the work of Carnelly and Haldane, in what may be called the criticism of house ventilation systems, and have only recently added an appreciation of the constructive work of Mr. T. W. Aldwinckle in this section of an architect's responsibilities. If anybody should take the trouble to go through the back volumes of the *Journal* for the past 20 years, he would find a large body of literature of the same character; so that in welcoming Mr. Jones as one of the newest workers in this not very thankful field, which is so commonly neglected by competent and trustworthy scientific laborers, we are not without some warrant of experience of the subject.

Mr. Jones approaches the matter as a chemist. As such, one would expect him to exhibit the usual defects of his qualities; and we frankly confess that it was with a suspicion of this sort at the back of our mind that we took up his pamphlet. How far the suspicion was justified will appear in the course of this article. To begin with, Mr. Jones very properly sets out all that the fathers of modern chemistry knew about the chemical composition of air. They thought that air is of pretty much the same composition everywhere and always; but this is now known to be not the case. One of the normal components of air, carbon dioxide, without which our atmosphere would not be air at all, nor capable of discharging a good half of its duty in the scheme of things, has come to be regarded by chemists as an "impurity." Mr. Jones does not fall into so vulgar an error. He admits that good air, away from towns, contains 3 volumes of carbon dioxide in 10,000. It does not sound much. Chemists have been obliged to state the composition of the atmosphere in terms of 10,000 volumes, in order to avoid having to give the proportion of carbon dioxide in less than whole numbers. Chemists, however, who are chemists first and men of good sound practical judgment afterwards, never stop to draw their readers' attention to the extent of the scale on which these figures are spaced. Three parts in 10,000! What does it mean? The plants know; but they cannot speak.

Having obtained his datum of the irreducible minimum of the quantity of carbon dioxide in normal country air, Mr. Jones next states that he has found 4.526 parts of carbon dioxide per 10,000 in the atmosphere of central Manchester. Without pausing to show that the difference is in any respect material, he immediately proceeds to state that "indoors the gases given off in respiration and by the burning of gas, candles and lamps are not rapidly removed even by the best systems of ventilation, and in too many cases they accumulate to such a degree as to be injurious to health." Observe the *petitio principii* of the conclusion. How do we know at what point the proportion of carbon dioxide in air becomes of itself injurious to health? If it be granted that there is a point at which the natural consequences of the absence of adequate ventilation in the case of occupied, warmed and lighted rooms become injurious to health, what is the nature of the danger and to what should it be ascribed? As a matter of fact, it is not known what the hygienic meaning is of the chemist's determination of the proportion of carbon dioxide in air which is being breathed by human beings, apart from other considerations. It is a far cry from the shed of a mineral water factory in England to the Black Hole of Calcutta; yet, in all probability, there would not be found a significant discrepancy between the amount of carbon dioxide usually present, quite harmlessly, in the former and in the worst ventilated enclosed space ever occupied for ordinary purposes by human beings.

Consequently, it is usual now to regard the proportion of carbon dioxide detected in a sample of air by the use of the ordinary method of chemical analysis as an indicator of the efficiency of the ventilation. This is a very different thing from valuing it as something "injurious to health" in itself, or even as indicating the existence of accompanying atmospheric components and conditions in the apartment from which the sample was taken. The difference is in the point of view. The point of view we prefer is that of the sanitarian, who starts with the assumption that a reasonable requirement in regard to ventilation is that every inmate of a room shall have a fresh air supply of 2,000 to 3,000 cubic feet per hour. The test for carbon dioxide will tell whether this requirement is being satisfied or not. The chemist has a different standpoint. In the person of Mr. Jones, he remarks that "some chemists maintain that the carbon dioxide in the air of rooms is uniformly distributed; others that the air near the floor is much purer than near the ceiling; some consider that the carbon dioxide in the air of a room ought not to exceed that in the outer air by more than two volumes in 10,000; others would only condemn air containing more than 19 volumes in 10,000 of air." Well might he remark that these asserted results are contradictory. But he himself runs a risk of mixing up two distinct issues—one of fact, the other of opinion. The question of the distribution of carbon dioxide in the air of rooms should be one of fact susceptible of experimental determination; that of the justification for the "condemnation" of air containing a certain proportion of carbon dioxide per 10,000 parts, is something which cannot be settled merely by what some chemists "consider" correct.

In view of the uncertainty prevailing even among chemists on these vital matters, and in view also of modern changes in methods of heating, lighting, and ventilation, Mr. Jones undertook an investigation of the question. It is significant of the chemist that the first thing he wanted for his purpose was a laboratory. He did not begin by investigating the conditions prevailing in a private dwelling house, or a school; but he procured the use of a small room in the most central part of Manchester, in which the experiments were conducted. "The air space of the room was 935 cubic feet, it had one fire place, one window and a ventilator at the roof, opposite the door. This ventilator measured 18 inches by 9 inches, and was always kept open." Not to be captious, it is necessary to interpose at this stage a query as to how far this "laboratory" represents an ordinary room, and therefore how far the results obtained may be regarded as of general applicability to all rooms. It is a very small apartment, to begin with, and was at the back of the building, where there was little circulation of air outside. The unscientific way in which the existence of an open ventilator "at the roof, opposite the door" is noted is remarkable. Nobody knows whether this hole acted as an inlet or an outlet, or even if it acted at all. There is no reason why any of the results obtained here should be regarded as applying to any other apartment, especially to one much larger, or even as strictly comparable among themselves. Thus the title of the pamphlet itself is a misnomer. It has nothing to say about the air of "rooms," in the plural, but only of one particular room, very much in the singular.

The very first result determined in respect to this "laboratory" would

1. *Journal of Gas Lighting*.

be queried by every expert in ventilation. After starting with the just proviso that, "in order to make the results comparable, the tests must be taken under similar conditions," Mr. Jones jumps to the statement that "in an ordinary room the best air is near the floor, it becomes less pure a few feet from the floor, and is most impure at the ceiling." Not one test is adduced, as having been made in an ordinary room, to prove this. We have already stated some objections to the acceptance of this little box of a laboratory as an ordinary room; but even if it were to be so taken, the following table is Mr. Jones's idea of similarly made and conclusive tests:

	Position.	Morning.	Afternoon.	Evening.
Carbon dioxide	Floor	5.117	6.639	Not observed.
in 10,000 vols.	Table	7.999	8.510	Not observed.
of air.	Ceiling	Not observed	Not observed	10.985

Surely, these "not observeds" militate somewhat against the clearness of whatever proof is intended to be deduced from this table. Mr. Jones cannot be ignorant of the fact that ventilating engineers and architects do not by any means hold that the air of rooms is purest at the floor level. On the contrary, they mostly believe that extraction of foul air at this level, if possible by an open fireplace, is very desirable. This is especially held to be true of apartments of any size. Even if the rising heated air is extracted at the ceiling level also, the assumed necessity of floor level extraction is never ignored. Obviously, therefore, the limited value of this starting determination of Mr. Jones is more certain than its degree of approximation to general truth. He had better make a fresh start, and ascertain from wider experience the usual distribution of carbon dioxide in the air of ordinary rooms.

In this laboratory, a series of experiments numbered from A to K was started last November twelvemonth. In the first set, tests of the amount of carbon dioxide and of the humidity of the air of the room were taken as a rule at three periods of each day—morning, afternoon and evening. The morning experiments were made before the fire was lit, or any gas burnt. The room was lighted by an ordinary No. 4 flat flame burner, assumed to be burning at the rate of 4 cubic feet per hour. It was also noted if the room had been occupied. That the apartment was somewhat "stuffy" is to be inferred from the circumstance that invariably the proportion of carbon dioxide in its air exceeded the outdoor average by about 3 parts in 10,000. Usually, after about 8 hours' respiration of one person in the room, with a coal fire burning and gas alight for an hour or two, the proportion of carbon dioxide taken at the table level went up to 20 parts in 10,000 or thereabouts. On one occasion the proportion went up to 48, starting at 9.5 parts in 10,000. This was on Dec. 15, the day being qualified as "fine and bright." Two days later, the weather mended. It became "foggy and dark," and the proportion of carbonic acid sank to 6.13 at the starting, rising to 16 after 4 hours of gas light. This illustrates the beautiful irregularity of these figures. As a rule, indeed, when the weather was rated as fine and bright, the starting proportion of carbon dioxide was higher than when it was dull. Thus, on Dec. 21 there was a thick fog all day; and we all know what that means in Manchester. The carbon dioxide was less than 9 at starting, and went up to 28 6 at night; whereas two days later, the weather being frosty and bright, the proportion started at about 10, but did not get beyond 19 parts in 10,000. Curiously enough, no temperature observations were made; and thus a simple guide to the state of the ventilation is not forthcoming.

The next set of experiments was made with the substitution of electric light for gas. This reduced the supply of extra carbon dioxide to respiration; while the fire and the open ventilator co-operated so efficiently that the proportion did not get much beyond 11 per cent. Mr. Jones remarks that the humidity is about the same in the ten sets of experiments. Next he had a gas fire, with gas light; the result being that the air was much drier, and there was more carbon dioxide in the room. He opined from this that the ventilating effect of the chimney was diminished by the absence of the open fire. The actual proportion of carbon dioxide was not larger; but it rose with greater uniformity every day. When it came to putting a gas cooker into the room, and turning on both oven and boiling burners, the result was very nearly catastrophic. "No satisfactory determinations were made with both the oven and top burners in use, because the room became unbearably hot and suffocating, and it was impossible to remain in it." Just so. This result, in short, gives Mr. Jones' show entirely away.

For what do all his labors amount to, as regards telling us what we did not know before? He sets out with some pomp fourteen conclusions as based upon the results of this investigation; but they can all be summed up in the statement that, unless the ventilation is adequate, the occupation by human beings with the burning of lights and fires so that the products of combustion mingle with the air of a room increases the proportion of carbon dioxide in that atmosphere. And the smaller the room the more marked this effect is likely to be; until if you put too large a gas-kitchener into a box room and turn all the gas on you really will not be able to stay there. If this is not sheer pedantry, we should like to be made acquainted with a finer specimen of the demonstration of the truth of the obvious. Where did Mr. Jones think to arrive at, in this precious galley? We notice that the *Manchester Guardian* ignores the size and character of the room which only an open fire and electric light, with a good sized hole near the top, kept decently sweet after an occupancy of seven or eight hours. The newspaper is sensible enough to express the wish that Mr. Jones had tried the effect of a common oil lamp—it might have added, and of a candle or two, without the ventilating effect of a coal fire. But this gleam of common sense is immediately obscured by the sapient observation that "it is easy to imagine the damage to health that must be caused by gas stoves, which, as is too often the case, stand out in a kitchen with no flue at all; and when that is also the living room of the family, the gas cooking stove is anything but the blessing to the poor which it is made out to be." In such cases the "family" probably has enough wit to open the window and also the door, which performance was barred by the conditions of Mr. Jones' experiment.

No! One is reluctantly driven to conclude that here again the Chemist, clever enough in his way, has failed to carry his points, because he has endeavored to fit every fact to laboratory conditions, instead of using the laboratory to reduce to order and method, if necessary, indications afforded by the actual experiences of everyday life. Of course, we all know that an electric incandescent light does not draw upon the oxygen of the apartment which it lights; and also that there is a limit to the number of people and of gas burners that can be packed into an apartment 10 feet square, with door and window shut, without striking effects upon the character of the contained air. Has Mr. Jones told the world anything more than this? If he has, we will gladly give his contribution to the sum of human knowledge as great publicity as we now do to the statement that his pamphlet is useless, looked at from the point of view of the practical person who buys his gas for consumption in ordinary rooms under conditions from which common sense is not deliberately excluded.

Some Notes on Inquiries for Engines.

[By Mr. J. A. Seager, London, England.]

The following are a few suggestions for guidance in inquiring for an engine which will be found to obviate much unnecessary correspondence, and facilitate the delivery of a satisfactory steam unit. It is remarkable how many omissions can be made in a single inquiry, apparently due, not so much to carelessness, as to a misunderstanding of the requirements of the engine builder. It would add greatly to the quality of the work done, besides cheapening the price and reducing the time of completion of work, if the requirements of the customer could be made to agree more closely with the standard practice of the engineers. The present notes are limited to main engines, such as those used for mill machinery, electric power plants, steamship propulsion, etc.

Horse Power.—It seems almost unnecessary to say that the horse power of the engine should be stated. The brake horse power should preferably be specified. In arranging for belt or rope driving, as a percentage of power is lost in transmission, a 5 per cent. increase should be made to the calculated brake horse power of the engine for short single drives, longer drives or multiple drives, of course, involving a greater percentage loss. It should be mentioned whether the driving is to be by rope pulley, belt pulley, or half-coupling for direct driving.

Steam Pressure.—I have seen a few engines from which the boiler pressure has been omitted, although it is obvious that an engine cannot give the same power with low as with high pressure steam. If no boiler has as yet been installed, the engine makers should be asked to state the most suitable boiler pressure. If the boiler is already laid down, its working pressure, less the loss of pressure along the steam pipes (which may be from 5 pounds in short, well designed lengths, to as much as 15 pounds in long or crooked arrangements), should be stated in the inquiry.

Speed.—The question of speed has an important influence, not only on the size of the engine, but often on the type also. For example, high speed engines—*i. e.*, from, say, 350 to 600 revolutions per minute—are now usually built vertical, and often with their cranks, con-

necting rods, valve motion, etc., enclosed. With slower speeds, however, horizontal engines with large cylinders and unenclosed mechanisms are employed, or in situations where ground space is begrudged (as on shipboard and valuable ground), these open type engines are built vertically. It is not always possible to give the engine maker much latitude as to speed at which he may run his engine, but wherever possible he should be allowed to select his own, or, at the very least, be given some slight range to choose from, in order that he may put in a standard, and, therefore, cheap size which will run economically.

Condensing.—Although an economy can be effected by the use of a condenser, an engine should not be changed over from an atmospheric exhaust to a condenser without one is sure that it is mechanically strong enough to stand the strains due to increased difference of pressure on the faces of the piston, and the greater mechanical force transmitted at the same speed. For this reason the engine maker should always be informed whether a condenser is to be used or not. Two other reasons may be cited: The distributing valves would be set differently for the two conditions, and possibly a smaller engine could be put in if it were to run condensing. With large sized engines it is often advisable to have a separate condensing plant for each engine, the pumps for which could either be worked by the main engine or by small auxiliary engines. It is preferable, however, to leave this point to the engine maker's discretion.

Description of Site, etc.—It would be disappointing if, after the engine was delivered, it was found to be too large in one of its dimensions for the space provided for it. The client should therefore either send a dimensioned sketch of his foundations, if supplied, or of the site, and also the height to roof, traveling crane, or other obstruction; or he should ask the engine maker to send an outline drawing giving the main dimensions of the engine when tendering. If the engine is to be erected inside a building, it would be well to make sure that there is a door or other convenient opening large enough to admit the engine when it arrives. A description of the site should always be sent. For example, it is of interest to the engine maker to know whether his engine is to be placed on board ship or on a concrete foundation, for in the latter case only will foundation bolts and plates be required. If the engine is to be erected by the engine people above or below ground level, this must be mentioned, as special lifting or lowering tackle would have to be provided. Details should be given as to the nature of the approach to the site—whether by land or water. In the former case it should be stated whether there is a road suitable for heavy traffic leading to the site; in the latter, whether there is a craneage wharf handy, and in both cases whether there is a traveling crane or other suitable means for handling the engine on site.

Erection.—In the matter of erection, however, the client has the choice of three alternatives: (a) giving the engine maker the order to erect the plant complete on foundations to be supplied by the client if they are requisite, and giving the above information in full detail; (b) asking the engine maker to quote only for skilled labor in erecting, the client himself providing all rough labor, cartage, etc.; (c) the client undertaking to erect the engine on site himself, in which case he should ask for quotations f.o.r. or f.o.b. at the nearest railway station or dock. The first method is the most costly but usually ensures good work. The last is perhaps cheap, and the result may be good or bad according to circumstances. It should be understood that only under exceptional circumstances and by special arrangement will engine makers allow in their price for building foundations for the engines, or for any masonry, builder, or joiner's work required, or for any excavating, cutting away, or making good again. If such work is required, it must be definitely mentioned in the inquiry, and care should be taken to see that the engineer has bound himself to do the work.

Combined Plants.—For many purposes where small powers and high speeds are required, such as centrifugal pumps, fans, electric dynamos, etc., it is customary to supply a direct coupled set mounted on a common bedplate, thereby cheapening the cost of erection. In such cases the engine maker will supply the base-plate with his engine, and will, if requested, receive the apparatus to be fitted at his works, couple the same to his engine, and deliver the complete set ready for erection on the foundations. As a matter of fact, he will often undertake to supply the combined plant complete, fitting his engine to suit the needs of the fan or dynamo to be supplied on receiving particulars of the work to be done by the plant. This method of ordering is recommended to non-expert purchasers, as it saves trouble for the client, and throws the onus of failure or defect entirely on the engine builder.

Tools, Accessories and Spares.—A clause should be included in the inquiry calling for all necessary tools, accessories and spares. A firm of good reputation will put in a suitable set without further information, but as a check the following items (though not forming a complete list) should be looked for—a complete set of spanners on rack, to be kept on rack except when being used on the engine, and any special tools required; spare springs and rings for pistons, and, if needed, valves; set of main brasses and smaller brasses; eccentric strap and governor springs if required; barring gear, tachometer, steam pressure and (if running condensing) vacuum gauges, etc. Cans, tanks, and filters for oil are not usually supplied by engine makers. It should be specially stated whether steam and exhaust stop valves are required with the engine, or whether they will be supplied with the pipework. Engine makers cannot be expected to connect their engine to steam, exhaust or drain pipes unless this was arranged before signing the order, and if connecting pipes or bends have to be placed between engine and main pipes, the position of the flanges on the latter with relation to the engine should be indicated when asking for a tender.

Nature of Load.—Different types of engines, equally high class in workmanship, are designed with varying intent. Some are meant to withstand severe shock, such as is experienced in rolling mills; others, such as are used in cotton mills and electric generating stations, are required to give very uniform speeds under varying loads; others again, where fuel and water are expensive, are designed to give extremely low water consumption and high efficiency; still others, destined to be placed in populous localities or on slight foundations, necessitate a careful balancing of moving weights to reduce vibration. If any such special conditions exist they should be stated, so that the engineer may form an opinion as to whether heavy frame work, Corliss valve gear, 3-cranked shaft, etc., are applicable. It should be carefully stated whether the direction of rotation of the engine is to be reversible or not, unless the particulars given of the work to be done imply one or other of these conditions as essential. If the engine is always to turn in one direction, it should be clearly stated which direction would be preferable, as "the engine to run clockwise, or counter clockwise, as seen from the end of the crankshaft next the coupling or pulley."

Steam Consumption and Efficiency.—Where steam consumption and efficiency are important, makers should be asked to state a guaranteed value for these in their tender at, say, full and half load. These values should be tested when the engine is built, either at the engine maker's works or on site. In the former case the client is at liberty to see the tests carried out and verify the results himself; or he can have a signed certificate of tested results. In the former case it almost goes without saying the traveling expenses of the client are not included in the engine estimate, and it would be a breach of courtesy at least to claim from the engine maker any sums spent in this way. If the tests are conducted on site, all fuel and water required for the test should be supplied by the client. It should be noted that the efficiency of an engine when new is generally some 5 per cent. less than when it has been running a short time, as the piston rings and bearings have not then come to a proper bearing surface.

Speed Regulation.—A point respecting speed regulation should be explained for the benefit of those who require very good governing. It is customary to test the action of the governor by suddenly throwing the full load off the engine, and expressing the increase in speed as a percentage of the original speed. This percentage will be guaranteed by the builder if required, and in good engines will not be above 3 per cent. But it is an instant or two before the governors will "get hold" of the engine after the load goes off, and the speed flies up possibly over 10 per cent. above normal. This excess of speed, though lasting only a short time (at most 10 seconds with good governors), would be sufficient to burn out a high efficiency electric lamp if the engine were driving a dynamo, or breaking the threads in a spinning machine if the engine were running a mill. For this reason, the percentage of instantaneous, as well as permanent speed variation, should be asked for, if there is good reason for so doing.

Time of Delivery.—An engine builder cannot keep a stock of engines, except possibly in small sizes, so that a period must be allowed him to compete his order. Since time is money, the client should ask in his inquiry for a guaranteed time of completion of work, which will obviate any misunderstanding as to what constitutes a reasonable time of delivery, and will enable him to discriminate between a maker whose shops are already too full of work and one who can supply the necessary power, labor and room to get the work through quickly. Such guarantees are, of course, given subject to delay due to strikes, lockouts, accidents, or other causes not under the control of the engine maker.

Although the above considerations by no means exhaust the points

which have to be remembered in ordering an engine—it would be unfortunate for the consulting engineer if they did—yet if those mentioned were attended to, the confusion of ideas which is apparent in many inquiries would be lessened, and the chances of getting a satisfactory engine much increased.

The Design of Steam Power Plants.—No. III.[1]

By Mr. Henry C. Meyer, Jr., in *Engineering Record.*

A sectional view of a typical horizontal return tubular boiler is given in Fig. 1. The method proportioning the different parts follows.

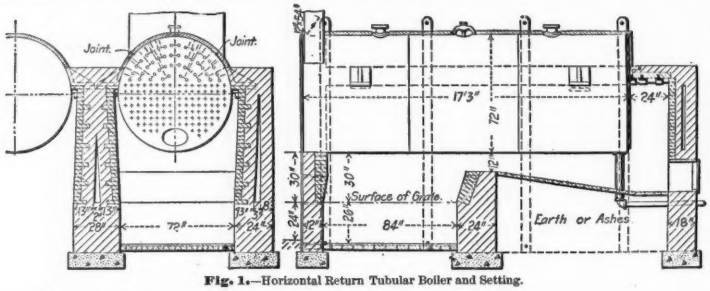


Fig. 1.—Horizontal Return Tubular Boiler and Setting.

Thickness of Shell.—One of the most satisfactory rules for determining the thickness of shell necessary in boilers of the fire tube type is that used by the steam boiler inspection department of the city of Philadelphia. The rule is as follows:

Working pressure = 2Tts ÷ Df., in which
T = the ultimate tensile strength of the plate in pounds.
t = the thickness of the plate in inches.
s = the efficiency of the longitudinal joint.
D = the diameter of the boiler in inches.
f = the factor of safety.

The factor of safety is usually taken at 5. With a tensile strength of 60,000 pounds and a joint efficiency of 0.08 the rule shows that with a $\frac{5}{16}$-inch plate, which is about as thick as is commonly used for the shell of an externally fired boiler on account of the resistance that a thicker plate offers to the transfer of heat at the girth seams of the boiler, the highest working pressure that can be carried in a boiler 6 feet in diameter is 150 pounds. A few horizontal return tubular boiler plants have been designed to carry a steam pressure of 150 pounds, but it is better to use water tube or internally fired fire tube boilers if this or a higher pressure is to be carried.

Braces.—Braces are used in horizontal tubular boilers to balance the pressure exerted on those parts of the heads of the boiler above and below the tubes and not close to the shell. If these parts are not braced, the pressure would cause the flat head to bulge outward. For a distance of 3 inches from the shell, and for a distance of 2 inches from the tubes, the head is usually considered to be sufficiently stiffened by the circumferential joint and the tubes not to need other bracing. Fig. 2

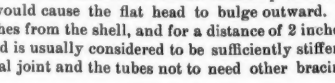


Fig. 2.—Unsupported Part of Head.

shows one of the heads in a horizontal tubular boiler and the part which has to be braced is indicated. Braces used in this work are usually of two kinds, the direct or through brace, or stay, which extends entirely through the boiler and joins the heads together and the diagonal or crow-foot brace. This latter is shown in Fig. 3. The head is connected

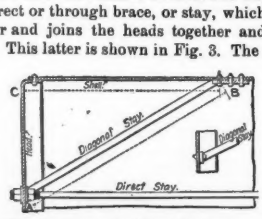


Fig. 3.—Diagonal and Direct Stay or Brace.

by it to the adjacent shell. The diagonal brace is preferred by the boiler inspection companies, as it is much easier to get inside of a boiler to inspect the interior with this brace than with the direct type. If the latter are used they should be sufficiently separated to allow a man entering the manhole opening to pass between them. The braces should be distributed uniformly over the area they are intended to support. Fig. 1 shows the manner in which diagonal braces may be distributed over the head. Five direct braces are sometimes used, three being placed in a lower row and two above, all being symmetrically placed with reference to the center. When direct braces are used the heads are frequently further stiffened by channel iron or angle irons riveted to the heads as shown in Fig. 4. If manholes are placed in one of the heads of the boiler the heads below the tubes should be braced.

In determining the number and size of braces the area in square inches of the surface to be stayed must be calculated and then the total pressure per square inch on this area. This latter divided by 7,500 will give the cross sectional area in square inches that must be provided in all of the braces combined, 7,500 pounds per square inch being the greatest strain to which a brace should be subjected. Cutting a thread on the end of the braces for the nuts, reduces the area of metal somewhat and this should be taken into account. Sometimes the ends of the braces are upset, that is, heated and

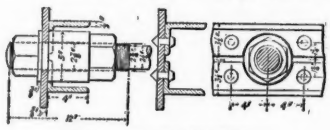


Fig. 4.—Connecting Direct Braces.

hammered at the end so that their diameter is increased slightly where the thread is to be cut.

With diagonal braces the pull exerted is not perpendicular to the head of the boiler. Hence the area of the brace should be calculated by dividing the surface supported by 7,500 and then increasing the result by multiplying the quotient obtained by the length in inches of the brace divided by the distance in inches that the head is from the point where the brace is attached to the shell. Referring to Fig. 3 the length of the brace is the distance *A B* and the distance from the head to the point where the brace is attached is the distance *C B*. The ratio *A B: C B* is the amount that the brace should be increased. For instance, if the surface to be stayed should require the pull of brace 1 square inch and the length *A B* should be 48 inches and the length *C B* 40 inches, then the area of brace actually required would be $1 \times 48 \div 40 = 6 \div 5 = 1\frac{1}{5}$ inches.

Supporting Boilers.—For many years the practice has been to support boilers by riveting two pairs of lugs on the sides of the shell, as in Fig. 2, and supporting them on cast iron plates built into the setting, rollers being placed under the pair of lugs in the rear, so that the movement due to expansion will be toward the rear. The principal objection to this plan is that the settlement of the walls of the setting, which is almost sure to occur, often throws almost the entire work of supporting the boiler on two lugs. A number of engineers suspend a boiler by riveting straps to the shell and passing hooked rods through them and through cast iron plates resting on I-beams laid across the top of the setting. Fig. 5 shows this construction. This is one of the

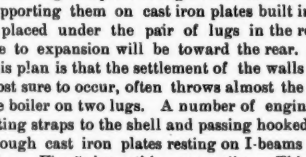


Fig. 5.—Method of Suspending Boiler.

best methods. If it is used it is well to have an iron plate of generous size between the beams and the setting for the former to rest upon.

Tubes.—Tubes should not be so closely spaced in a boiler as to interfere with a proper circulation of water in them. Three, 3½ and 4-inch tubes are commonly used in horizontal tubular boilers, the latter being

1. *Ante*, p. 125.

generally used in large size boilers, the size decreasing with the diameter of the boiler. Barrus states that a certain ratio of tube area to grate surface is necessary to give the best result with different fuels, a ratio of nine to one or ten to one being proper for anthracite coals and six to one or seven to one for bituminous coals, the difference being due to the large volume of gases with the latter coals, which requires a large area in the tubes to pass the gases at the proper velocity for giving off their heat. Tubes should be placed in vertical rows and not staggered. They should be located as far apart as the number necessary to put in the boiler will permit; for this will permit a better circulation, which is essential when the boiler is operating at high rates of combustion.

By means of Table 1 and Figs. 6, 7 and 8 the proper method of

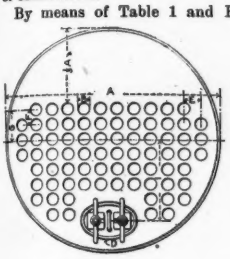


Fig. 6.

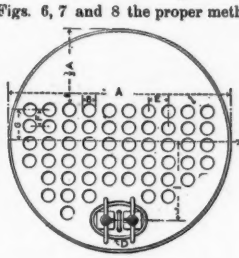


Fig. 7.

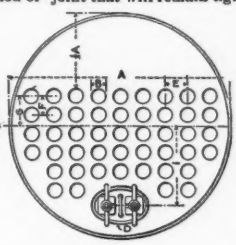


Fig. 8.

locating and spacing tubes in return tubular boilers may be found. The three figures refer respectively to 60-inch boilers with 3, 3½ and 4-inch tubes. These data have been taken from Mr. W. M. Barr's work, "Boilers and Furnaces." Fig. 4 has also been taken from the same source. In using Table 1 to determine the number and location of tubes for boilers of different diameter than those shown in the figure, a drawing of the tube sheet should be made on which the centers of the tubes can be located from the data given in the tables. Barr states that "the distance from the side of a tube to the inside of the boiler shell should not, in the case of a 36-inch boiler, be less than 2 inches, for a 48 inch boiler it should not be less than 2½ inches, and for a 50 inch boiler and larger, the distance should be not less than 3 inches, to secure good water circulation." Calculations have been made showing the heating surface per lineal foot of boiler for each of the different sizes given in the table, also the usual length of each. The tube area is also given and this may be useful in comparing the tube area with the size of grate. The method of determining the proper amount of heating and grate surface was explained in a preceding chapter.

Riveting.—The subject of riveting will be discussed in a later number.

Boiler Settings.—Fig. 1 shows a longitudinal and cross-section of a popular form of setting for return tubular boilers. It should be constructed of hard red brick, laid in lime or cement mortar, and the entire setting ought to be lined with fire brick with every fifth course laid as headers, so that any part that might become damaged could be easily renewed without taking out the entire lining. Sometimes, to economize, the furnace as far as the bridge wall only is lined with fire brick. The fire brick should be laid in fire clay, using as little of it as possible. In the drawing the grate has a width equal to the diameter of the boilers and the side wall is battered so as to leave a space of 3 inches at the level where the setting closes into the boilers. The side walls are provided with air spaces, as shown, which one necessary to prevent the wall from cracking.

If fire brick, backed with common brick, is used the side walls have to be 13 inches thick and the air space should be about 2 inches wide at the bottom and diminish as its sides converge. Two 13-inch walls and a 2-inch air space make the entire thickness of the walls between the boilers 28 inches. This diminishes at the top as shown. It is sometimes difficult with low grade fuels and natural draft to burn sufficient coal on the grate of a horizontal tubular boiler to obtain as high evaporation as should be obtained, hence it is desirable, if these boilers are apt to be fired with such fuel, to place the boilers a little farther apart and make the side walls perpendicular and at a distance apart at the grate equal to the diameter of the boiler plus 6 inches. This makes the grate 6 inches wider and increases the grate surface materially. If a boiler it constructed in this way, it is a simple matter to diminish the size of the grate by bricking off the sides and rear. It is difficult to fire a grade more than 6 feet deep, although they are sometimes made 7 feet in depth, in large boilers. Furnaces over 5 feet wide should have two fire and two ash pit doors.

The top of the bridge wall of the boiler is usually about 10 or 12 inches from the bottom of the shell, and the space behind may be filled with earth and paved with common brick or left empty. Curving this combustion chamber to conform with the shell only reduces its size, which is a disadvantage with bituminous coal and of no use with other kinds. The rear wall should contain an air space and be provided with a clean-out door about 16 × 20 inches. The wall should be located at a distance of 18 to 24 inches, depending on the size of the boiler, from the back head.

The back connection, that is, the connection between the rear wall and the head, is a source of more or less trouble on account of the expansion and contraction of the boiler, and the difficulty of making a joint that will remain tight. One method is to spring an arch across having one end resting on the wall and the other upon an angle iron riveted to the back head of the boiler. The arch consists of brick resting in an iron framework. The Hartford Steam Boiler Inspection and Insurance Company uses an arch somewhat similar to that shown in Fig. 1.

The grate should be at a level of 24 inches above the floor and the shell from 28 to 30 inches above the grate with anthracite coals and from 36 to 42 inches if bituminous coals are to be burned, as the gases from the latter do not burn properly if the flame comes in contact with the cooler boiler surfaces. The floor of the ash pit should be paved with brick laid on edge and flushed with a thin cement mortar so as to be water tight. This floor is usually 3 to 6 inches below the floor of the boiler room.

TABLE I.—*Tube Spacing and Heating Surface in Horizontal Tubular Boilers.*

Tubes				Heating Surface per Lin. Ft. of Boiler, Sq. Ft.	Size of Manholes, Inch.	Tubes, Center to Center		Center of Boiler to Center of Upper Row Tubes, Inch.	Usual Length of Boiler, Ft.
Diam. Boiler, Inch.	Diam. Inch.	No.	Internal Area, Sq. Ft.			Horizontal, Inch.	Vertical Inch.		
A.	B.				D.	E.	F.	G.	
48	3	46	1.94	43.67	9 × 14½	4¼	4	6½	10 to 12
50	3	52	2.19	48.69	9 × 14½	4¼	4	6¾	10 to 12
52	3	54	2.28	50.58	9 × 14½	4¼	4	7⅛	10 to 12
54	3	60	2.53	55.60	9 × 14½	4¼	4	7⅜	10 to 12
56	3	64	2.70	59.06	11 × 15	4¼	4	8	10 to 12
58	3	70	2.95	64.09	11 × 15	4¼	4	8¼	10 to 12
60	3	76	3.21	69.11	11 × 15	4¼	4	8½	10 to 12
48	3½	34	1.97	38.68	9 × 14½	5	4½	6½	12 to 14
50	3½	38	2.20	42.66	9 × 14½	5	4½	6¾	12 to 14
52	3½	46	2.67	50.31	9 × 14½	5	4½	7⅛	12 to 14
54	3½	47	2.73	51.53	9 × 14½	5	4½	7⅜	12 to 14
56	3½	50	2.90	54.60	11 × 15	5	4½	7½	12 to 14
58	3½	52	3.02	56.74	11 × 15	5¼	4½	7⅞	12 to 14
60	3½	56	3.25	60.71	11 × 15	5¼	4½	8⅛	14 to 16
62	3½	60	3.48	64 72	11 × 15	5¼	4½	8½	14 to 16
64	3½	64	3.71	68.67	11 × 15	5½	4½	9	14 to 16
66	3½	70	4.06	74.49	11 × 15	5½	4½	9⅛	14 to 16
54	4	36	2.75	46.17	11 × 15	6	5	7	16 to 20
56	4	38	2.90	48.59	11 × 15	6	5	7¼	16 to 20
58	4	40	3.05	50.99	11 × 15	6	5	7⅜	16 to 20
60	4	47	3.59	58.63	11 × 15	6	5	8	16 to 20
62	4	49	3.74	61.04	11 × 15	6	5	8¼	16 to 20
64	4	51	3.89	63.45	11 × 15	6	5	8½	16 to 20
66	4	56	4.27	69.00	11 × 15	6	5	9	16 to 20
68	4	62	4.73	75.59	11 × 15	6	5	9¼	16 to 20
70	4	64	4.88	78.01	11 × 15	6	5	9⅜	16 to 20
72	4	74	5.65	88.79	11 × 15	6	5	10¼	16 to 20

Specifications.—It was thought advisable to print that portion of a typical boiler specification which relates to the boiler, its setting, fire tools, etc., it being understood that those other clauses which are usually incorporated in a specification relating to the manner in which the work is to be done by the contractor, etc., are omitted. The specification is divided into sections and in some cases comment or explanation follows a section. A form of specification for high grade work follows:

Intent of Specifications.—It is the intent and purpose of these specifications to provide for the furnishing and installation of a complete boiler plant comprising the boilers, setting, grates, fronts, feed and blow-off piping, gauges, smoke breeching, flues, dampers, and such

details as are hereinafter specified, all complete and erected ready to generate steam.

Materials.—The shell and heads of the boiler are to be constructed of open hearth fire box steel having a tensile strength from 55,000 to 60,000 pounds, an elastic limit of one-half the tensile strength, and an elongation of 25 per cent. in 8 inches. The steel plates must be capable of being bent flat on themselves without rupture; and also, after being heated to a cherry red and cooled in water at 62° F., be bent around a mandrill of a diameter equal to one and one-half times the thickness of the plate without fracture. Coupons of the dimensions shown in Fig. 9 are to be cut from each plate marked for identification and given to the engineer.

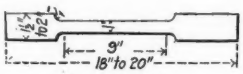


Fig. 9.—Test Piece.

Shell and Heads.—The shell plates are to be — inches thick, the heads — inches thick. The shell is to be in three courses (or two courses if the boiler is small enough), and the middle one must be of the smallest diameter. The edges of the plates must be planed before they are put together and caulking must be done with a round nosed tool. Heads must be flanged to a radius not less than 1½ inches and they must be annealed after flanging. The flange must be free from cracks and flaws.

Riveting.—The girth seams are to be of the single riveted lap joint type, the pitch of the rivets to be — inches; lap — inches and rivets — inches in diameter. The longitudinal seems are to be placed well above the fire line, and to be of the butt type triple riveted with double welt, as shown in the drawing (which the engineer should supply). The rivet holes are to be drilled or punched ¼ inch small and afterward drilled or reamed out to full size. A reamer must be used instead of the drift-pin. The burr is to be removed and the rivets driven by a hydraulic or pneumatic riveter as far as possible. Rivets are to be of charcoal iron, or steel having the same physical properties as were specified for shell plates, and rivets must be capable of being bent back upon themselves without developing flaws or cracks.

Note.—Some specifications intended for high grade work demand that the rivet holes shall be punched ¼-inch small and the shell then rolled and the lapping ends bolted together while the holes are drilled out the full size. This insures that the holes in one end of the sheet shall come opposite those in the other end and much better riveting will be the result. Oftentimes the holes are punched out to the full size, but authorities unite in saying that the metal immediately surrounding a punched hole is weakened. Hence it is better to punch the holes small and drill or ream them out to full size.

Bracing.—The heads are to be braced to the shell by — radial solid cross foot braces, — on each head distributed as shown on drawing. The braces must be of — inch stay bolt iron at least 3 feet long, forged up without a weld and be connected to the shell by two — inch rivets. Each brace must be so located as to lie in a plane passing through the axis of the boiler.

Note.—If through braces are used, their number and diameter should be given and their location shown on a drawing. If the ends of the braces are to be upset, or if channel or angle irons are to be riveted to the heads to stiffen it, it should be so stated, and their weight and dimensions specified, or shown by a drawing.

Tubes.—The tubes are to be — in number — inches in diameter, — feet long, of the best charcoal iron lap welded or of steel. The tube holes in the head are to champfered and the tubes are to be carefully expanded and beaded over at the ends. The tubes are to be located as shown in a drawing (which the engineer should supply).

Manholes.—A pressed steel manhole frame, 11 by 15 inches, is to be riveted to the top of each boiler, with the long diameter girthwise (in a position indicated by the engineer), and another is to be riveted to the front head below the tubes. The usual manhole plate, gasket, yoke and bolt are to be provided by each.

Hand-hole.—A 4 by 6 inch hand hole is to be placed in the back head below the tubes. The plate, gasket, yoke and bolt are to be provided.

Nozzles.—Each boiler is to have 2 inch cast iron nozzles riveted to the boiler in the middle of the front and rear courses. The nozzles are to be drilled to fit the A. S. M. E. standard flange schedule.

Lugs.—The boiler is to be supported on the brickwork by four heavy cast iron lugs riveted to the shell, one pair to the front and the other to the rear course. The front lugs shall rest upon bearing plates. Three 1-inch rollers shall be placed under each rear lug between it and the bearing plates, which are also to be provided.

Note.—If the boiler is to be supported by straps from beams laid across the top of the setting, it should be specified and a drawing showing the detail of the method of hanging the boiler given

Feed Pipe.—The contractor is to supply and connect a — inch wrought iron feed pipe that is to pass through a brass bushing in the front head of each boiler, at one side and 3 inches above the tubes and extending to the rear of the boiler.

Tools.—Each boiler is to be provided with a fire shovel, slice bar, hoe and poker. The boilers are to be provided with one tube scraper and the necessary hose and nozzle for blowing soot from the interior of the tubes.

Blow off.—A blow-off connection is to be provided at the bottom of each shell at the back end. The — inch opening in the shell is to be tapped to receive a — inch blow-off pipe and the opening is to be reinforced by a — inch steel plate riveted to the shell. The blow-off pipe is to be protected by a fireclay tube and run in the manner shown in the drawing to a blow-off main provided for in another contract. The boiler contractor is to supply a — inch blow off cock of —— make for each boiler and the fireclay tube for protecting the blow off pipe.

Castings.—Each boiler is to be provided with a cast-iron flush front, cheek plates, mouth plates, one (or two) fire and one (or two) ash pit doors and clean-out door for rear wall, arch plates, grate bars, bearing bars, T bars for back connection, tie rods, wall braces, etc. The grate bars shall contain 50 per cent. air space and are to fit a grate — by — inches and to be suitable for burning —— coal. The fire doors are to be fitted with registers and perforated linings, and the ash pit doors registers and the clean out door a lining.

Fittings.—Each boiler to be furnished with the following fittings, which are to be connected: One water column upon which can be mounted a steam gauge, gauge cocks and gauge glass connected to the boiler by 1½ inch pipe; three — inch gauge cocks; one — inch gauge glass; one — inch steam gauge of —— make and provided with stop cock and siphon.

Hydrostatic Test.—The boiler must be made sufficiently tight to stand without leaking when subjected to a hydrostatic test of a pressure 33⅓ per cent. in excess of the normal working pressure of — pounds.

Setting.—The boilers are to be set in accordance with the accompanying drawing. The settings are to extend 6 inches below the floor level and are to be of the best brick laid in lime mortar and the entire setting is to be lined with the best quality of fire brick laid in fire clay and with every fifth course set as headers. The setting is to be closed in at the shell 5 inches above the center line of the boilers, except at the lugs where the setting closes in two courses below the lugs. The boilers are to be supported by lugs as previously stated and care must be taken that bearing plates are placed level and that rollers under the rear and middle lugs are placed perpendicular to the axis of the boilers. The foundations for the setting are to be laid by the contractor.

Smoke Flue and Chimney.—If an iron chimney is to be used, the writer believes in small work that it is best to put the boilers, smoke breechings and flue, damper and damper regulator and chimney in the boiler contract for the reason that all of them affect the operation of the boiler. The method of proportioning the chimney, etc., will be discussed later. The boiler specification therefor should indicate the thickness and dimensions of the smoke flue. Provision should be made for a damper in the uptake of each boiler that may be closed when the boiler is undergoing repairs. There should be a damper in the main flue and this should be under the control of an automatic damper regulator which opens or closes the damper according as the steam pressure is respectively below or above the normal. The smoke flue should have doors through which the soot may be removed when necessary.

Specifications for Water Tube Boilers.—An engineer's specification for water-tube boilers can only be a very general statement of what is wanted, for the reason that such boilers vary greatly in design. The engineer can, however, describe what he wants and ask each bidder to supply information enabling him to understand thoroughly what each bidder proposes to furnish. The engineer should state in his specification the number of boilers he wishes to purchase, the amount of heating and grate surface each is to contain, the location of the plant for which they are wanted and the name of the owner or owners of the plant. If the boilers are to be erected and placed in running order by the builder, it should be so stated. The engineer should state the kind of coal to be burned, the kind of service to be required of the boilers and the dimensions of the chimney and flues. It is well to furnish a sketch showing the location of the boilers, flues and chimney. If a

mechanical stoker is to be used the boilermaker should be asked to furnish a boiler setting to suit. The engineer should require each bidder to furnish detail drawings showing all parts of the boiler and setting, in such a way as to show the facilities for cleaning and inspecting the parts and the manner of making renewals. He should ask for the physical qualities of the metals used; the material of which the tubes are made; the name of the manufacturer of the different fittings used, such as the safety valve, blow-off cocks, water and steam gauges; the character of feed piping, whether iron or brass.

For certain types of water tube boilers with straight tubes slightly inclined from the horizontal and connecting with vertical or nearly vertical headers at the front and rear of the boilers, the headers connecting with combined steam and water drums, there are usually some different arrangements of tubes that will meet a specification calling for a certain heating surface. For instance, there may be sixty 18-foot tubes so arranged that there are ten tubes in width and six tubes in height or there may be twelve tubes wide and five tubes high. The latter arrangement would mean a wider boiler costing more, but giving a wider and consequently larger grate that might be needed with low grade fuels. It is probable, the heating and grate surface and coal burned being the same, that a high narrow boiler of this type will give a better efficiency than a low wide one. If the boilermaker is to supply and erect the breechings, smoke flues, chimney dampers and damper regulator it should be stated in the specifications.

If the engineer proportions the boiler it is hardly fair to exact a guarantee from the maker as to the efficiency of the boiler. He should, however, guarantee that the boiler will operate at 50 per cent. over its rated capacity without showing signs of depreciation.

"Accidental" Impurities in Carbide of Calcium.

Mr. Felix B. Ahrens, of Brussels, Belgium, writes on this topic as follows:

In various samples of carbide from different sources we find large metallic morsels which have been identified as ferro-silicon or silico-carbide of iron. The high proportion of iron in this substance precludes the idea that it is due to impurities in the coke or the lime; it appears more to be due to the fusion of the metallic clips serving as holders for the electrode, and this fact seems to indicate a considerable consumption of the electrodes. This inconvenience is, as a rule, due to the faulty construction of the furnace, inasmuch as it allows too great a consumption of the electrodes, or else does not allow of good regulation. It is extremely improbable that this ferro-silicon is due to a mistake in the manufacture, as it is very frequently found in commercial carbide of calcium.

A short time ago I found in a carbide of calcium some of these metallic morsels, a few of which were several c.m. in diameter, and I was able to collect a certain quantity. They contained not only iron and silicon, but also a large proportion of copper. It may easily be imagined that this latter metal came from the conducting wires and fell into the furnace after a short circuit. This silicide had a crystalline fracture, was fairly friable, and strongly resistant to chemical reagents. Boiling hydrochloric acid had absolutely no action on it, and boiling aqua regia very little. Of a piece weighing 0.5 grm. only 0.1382 grm. was dissolved after boiling three days with this latter reagent. The alkalies and alkaline carbonates attack it very easily when fused.

To effect its analysis we begin by breaking up a few pieces taken at random, in a steel mortar, and then pulverise them in an agate mortar; the powder is then fused with the double carbonate of potash and soda; during this operation a mass of green flames is given off.

We can never manage the complete disaggregation of the silicide in one operation, even after maintaining the fusion for several hours; it is necessary to submit the silica separated by means of hydrochloric acid to the same treatment once or twice more. After completing the operation in the ordinary manner, by making the silica insoluble by means of hydrochloric acid in the presence of a small quantity of chlorate of potash, we precipitate the iron by a large excess of ammonia, so that the copper will remain in solution. The oxide of iron is re-dissolved and re-precipitated three times under the same conditions to get it absolutely free from copper. Finally the copper itself is precipitated by means of sulphuretted hydrogen in hydrochloric solution.

As the silicide contains carbon, this latter is estimated by combustion in a current of oxygen.

0.1595 grm. of silicide gave—

0.006 grm. CO_2 = 1.03 p.c. C.

0.4016 grm. of silicide gave—

0.2362 grm. SiO_2 = 27.61 " Si
0.3384 " Fe_2O_3 = 58.96 " Fe
0.654 " Cu_2S = 12.76 " Cu

100.36 p.c.

We found certain differences on examining the physical properties of various morsels of silicide; some were of a grey color, and others, more numerous, were slightly red. The first had a hardness of 8 to 9, and were friable and easily powdered; the second had a hardness of 7 to 8, and were more coherent. Finally we met with a small quantity of flattened cakes, grey in the interior and bright yellow on the surface.

These three different substances were analyzed by the method described above, and found to have different compositions. The grey portions with the hardness 8 to 9 contained—

0.2642 grm. of the material gave—

0.1884 SiO_2 = 27.00 per cent. Si
0.2288 Fe_2O_3 = 60.62 " Fe
0.0154 Cu_2S = 4.66 " Cu
0.0186 $P_2Mg_2O_7$ = 1.97 " P

The remainder consisted principally of carbon.

The analysis of the reddish pieces gave the following results:

0.6682 grm. of the material gave—

0.3436 SiO_2 = 24.00 per cent. Si
0.4924 Fe_2O_3 = 51.58 " Fe
0.1988 Cu_2S = 23.76 " Cu
Remainder = 0.66 " C

As for the flattened cakes, they were analyzed after being powdered and thoroughly mixed, and gave the following results:

0.3475 grm. of the material gave—

0.1453 SiO_2 = 19.6 per cent. Si
0.2904 Fe_2O_3 = 58.5 " Fe
0.0956 Cu_2S = 21.9 " Cu

100.0 "

The Photometry of the Arc.

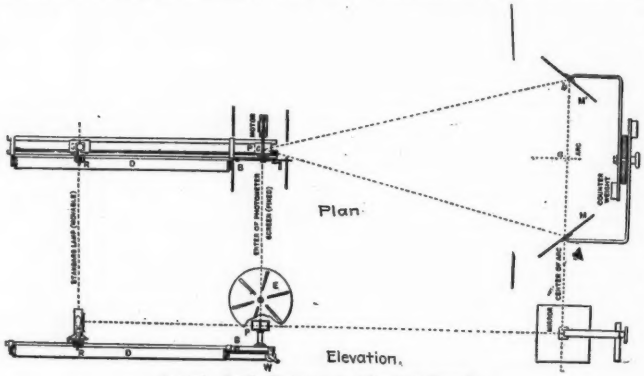
Prof. C. P. Matthews, of Purdue University, in a preliminary report from the Committee for Investigating the Photometric Values of Arc Lamps, appointed at the May meeting of the National Electric Light Association, remarks:

If one compares the results obtained by different investigators on the luminous industry of the arc, he finds great discrepancies. Indeed, so discordant are the results that the opinion has been advanced by some that such measurements are almost worthless, and that any attempt to obtain consistent and reliable data on the luminous intensity of the arc might well be abandoned at the outset. This is undoubtedly an extreme view, and, personally, I do not share it. We have to consider the question: With what degree of accuracy shall we be content? Anything comparable with the accuracy to be obtained in purely electrical measurements is not to be thought of. On the other hand, that the results from different tests should be concordant to a degree no better than 50 per cent. would seem to indicate either that such tests have been made under widely different conditions—that is to say, as to carbons, globes, etc.—or that sufficient time and study have not been bestowed on the methods employed. I am of the opinion that an absolute accuracy of less than 10 per cent. and a relative accuracy in any one series of tests of less than 5 per cent. are quite within the range of possibility.

It is apparent that the difficulties met in the pursuit of good results in arc light photometry may be classified under two heads: (1) Those peculiar to the source, and (2) those peculiar to the method.

Of the first class, none is more troublesome than the great change in the intensity in any given direction, due to the wandering of the arc over the surface of the carbon tips. For instance, if the arc shifts suddenly from the remote side of the carbons to the side towards the photometer, the resulting change in luminous intensity may be 200 per cent. Under these circumstances, the only hope of getting a value representing the mean intensity, at least with the use of one photometer arranged in the ordinary way, lies in taking a relatively great number of readings referred to time, and in integrating the result. To accomplish this, I have employed a device to record the settings mechanically. While this is a labor saving device, it does not obviate the necessity of taking many settings, nor lessen the number of computations. Since taking up the work for your committee, I have constructed a piece of apparatus that greatly reduces the fluctuation in the illumination on the photometer disk, and hence gives a good result with a greatly diminished number of settings. The method involved may be well designated as the double mirror method, and is, so far as

I know, new.[1] It consists in nothing more than the employment of two mirrors instead of one, and in taking light simultaneously from opposite sides of the arc at the same inclination to the vertical, both mirrors being capable of ready adjustment at any angle in the vertical plane. The arrangement of apparatus for carrying out this plan is shown, somewhat diagrammatically, in Fig. 1. The two mirrors, (*M*), (*M'*), are mounted at the extremities of iron arms, and are suitably counterbalanced, as shown. The arc is fixed in the center of rotation at (*a*), and light is incident upon the photometer disk at (*c*), by the two paths shown in dotted lines, direct light from the arc being cut out by a screen not shown in the figure. This plan necessitates a fixed photometer, *P*, and, in order that a variable illumination may be produced to balance that due to the arc, I have arranged a cord and windlass, *W*, permitting the observer to move with facility the secondary standard, *S*, which is a glow lamp. At *D* is a long, wooden cylinder, upon which is wrapped the paper to receive the records of the test. These records are made by an electro-magnetic device, *R*, which punctures the paper whenever an electric circuit is closed at the button, *B*.



Apparatus for the Measurement of Luminous Intensity.

The observer, seated before the photometer in a closely screened inclosure, operating with one hand the windlass, and with the other the push button, is enabled to take settings with relatively great rapidity and accuracy. At a point 200 cm. to the right of the photometer disk, a reserve standard is mounted on an arm that may be swung into a position in line with the bar. This reserve standard was carefully evaluated once for all in terms of the Hefner lamp. To determine the intensity of the secondary standard, *S*, it is only necessary to turn the reserve into position and record a series of readings in the same way as for the arc. This operation is carried out at the end of each test, or more frequently if any change has been made in the temporary standard. Thus, it will be seen that, should the lamp under test be found particularly weak at certain angles, the limit of the bar might be reached in the attempt to get a setting. In such case, it is necessary to stop down the temporary standard and to again refer it to the reserve. I may add that the reserve is never allowed to burn more than a few minutes, and cannot deteriorate under such conditions of use.

With this disposition of the mirrors, the angle of incidence at the photometer disk is constant. In Fig. 1, this angle is shown at more than twice its actual value, in order to reduce the length of the drawing. The real value of this angle is 5° 54′. To make a correction for this lack of normal incidence would mean the division of the intensities, as found, by the cosine of 5° 54′, or .9947. Failure to do this introduces an error of about one-half of 1 per cent., which is clearly neligible in work of this character.

If, at a given instant, I′ be the intensity of the arc to the left, and I″ the intensity to the right, d the fixed distance, *abc*, d_s the distance of the movable standard and K the mirror coefficient, we have as the mean intensity,

$$I = \frac{I' + I''}{2} = \left[\frac{d2}{2d_s^2}\right] \times \frac{I_s}{K}$$

The factor in the bracket was computed once for all for values of d_s throughout the range of the bar, and these values were laid off as graduations on a long T-square. To work out the intensities in any particular test, it suffices to pin the record from the drum upon a long table, and to read directly from a T-square the values of the bracketed expression corresponding to the punctures in the paper. The mean of these values for any one position multiplied by the factor to the right of the bracket gives the intensity for that position in Hefner units.

It is, of course, necessary in testing sources with large globes or shades to use mirrors of such size that the globe or shade may be seen in its entirety, when the eye is placed at the point *C;* and it is further necessary that the distance *abc* should be large. It is important to note that the double mirror method, while enormously diminishing the fluctuation due to wandering of the arc, can have no effect on such fluctuations as are due to variations in length of the arc, or to variations in the current strength. Of the difficulties peculiar to the method, the most serious arises from the attempt to compare the arc with a standard of different color. It is well known that when the color difference is marked, the setting partakes of the nature of a guess, differing not only with different observers, but with the same observer at different times. To minimize the error due to this cause, I have made use of the physiological fact that, as the illumination of two surfaces tends toward zero, the eye appreciates their difference in color to a less and less degree, and is thus able to estimate an equality in luminosity unhampered by the sensation of color. Thus, the method of winking, or half closing the eyes, has been used by many experimenters to diminish the color sensation. These latter processes are very fatiguing to the observer, and I have adopted the plan of diminishing the intensity of the photometric field by the use of a rotating sectored disk, showed at *E*, Fig. 1, of very small angular opening. Ferry has found that the use of a sectored disk to reduce the intensity of one source in comparison with another of different color introduces an error, because the ratio of the light transmitted to light cut off does not appear to be the ratio of the open to the closed sectors when the opening is small. It will be noted that the disk in the figure is so placed as to diminish equally both sides of the photometric field, and hence one would not look for an error of this character.

The values of luminous intensity in these tests are expressed in terms of the Hefner amylacetate lamp. They may be reduced to British candles by multiplying by the factor .88. I would call attention, however, to the fact that this is a little more than multiplying by an arbitrary constant, since no one knows definitely what the luminous intensity of the British candle is. On the other hand, the Hefner unit has met with an international sanction, and is quite generally accepted as a unit, far from perfect, but possessing, especially for practical purposes, fewer faults than any unit thus far proposed. I trust that the association may see fit to adopt a complete system of photometric units, as proposed by M. Blondel. There is particular need that a unit of "luminous flux" should receive general acceptance.

When an opalescent inner globe is used, the globe itself becomes more or less luminous by diffusion. The diffusion differs with the height of the arc in the globe, that is to say, with the length of the lower carbon. To ascertain the magnitude of this effect, I have carried through three tests on the same lamp and inner globe, and also the same carbons, the lower carbons being cut successively to lengths of 4¼, 2¾ and 1½ inches. An inspection of these results shows that least light is obtained with the arc at the top of the globe, and most light when the arc is at the mid-point. This is explained in part by the fact that with the arc at the top a good part of the luminous flux is incident upon the non reflecting surface of the gas cap.

In order to determine the status of the direct current, inclosed arc as found commercially on the market, it seemed desirable to study first the questions of luminous intensity, power consumption and efficiency, taking the lamps as supplied by the makers, but operating under a certain uniformity in conditions. These conditions are (1) The same brand of carbons throughout; (2) an opalescent or milky inner globe, and a clear outer globe; (3) an opalescent inner globe, and an opal ground or milky outer globe. To these, I have added in certain cases a test with no outer globe whatever, in order that the absolute, as well as the relative, absorption of the outer globes might be found.

The lamps are fitted with the proper lengths of carbons, and adjusted, as nearly as possible, to the voltage at the arc named in the makers' specifications. They are then allowed to burn until thoroughly heated before the test begins. One observer maintains the terminal electromotive force constant, and takes readings of the current through out the test, while another operates the photometer. The values of

1. Since writing this, I find that the eminent French photometrist, Blondel, has embodied this principle in his admirable Photomesometer.

current given are therefore the mean of many readings. From the records taken off the recording drum the values in the tables are computed. These values are then plotted in polar co-ordinates, as shown in the curves below, and also in rectangular co ordinates in the well-known Rousseau diagram, which latter is integrated by the planimeter to get the mean spherical intensity. Eight direct-current, 110 volt lamps and seven alternating-current inclosed arc lamps for constant potential circuits have been tested up to the present writing.

ITEMS OF INTEREST FROM VARIOUS LOCALITIES.

MR. ARTHUR B. CALEF, President of the Middletown (Conn.) Gas Light Company and the oldest member of the Middlesex County bar, died at his home in Middletown the morning of August 17th. He was much respected, and his fame as a lawyer extended through the Middle States as well as New England.

A CORRESPONDENT at Dover, N. J., writing from that place under date of August 23d, incloses the following: "At a meeting of the Dover Council, held last week, the committee to whom had been referred the matter of granting a gas franchise to the Van Syckel Water Gas Company or the Dover Illuminating Company presented the following report: The committee believe that a good gas system constructed on right principles, operated by a responsible company, with pipes so extended that gas would be within reach of all, would be for the best interests of the town, but that a gas franchise should be so guarded that gas should be furnished at the lowest possible price, and the town have the privilege of purchasing the plant at any time, at its actual value, to be determined by arbitration. We would also suggest that a percentage of the gross receipts be paid the town for the franchise. We, therefore, recommend that neither of the applications be granted, and that an opportunity be given for other companies to submit propositions for building and maintaining a gas plant." This curious report with its queer looking and sounding recommendations, was adopted. The fact is that no gas franchise will be passed by the authorities until the local electric light company of Dover agrees to the proposition. Meanwhile it is a fact positive that a well managed gas company in Dover would pay its proprietors handsomely.

THE Camden and Burlington (N. J.) County Gas Company is to be reorganized under the name of the South Jersey Gas and Electric Company.

MR. MYRON C. TAYLOR, representing Messrs. George Rodwell, Geo. H. Rodwell and Charles A. Lux, of Clyde, N. Y.; the Morris Machine Works, of Baldwinsville, N. Y., and the Westinghouse Electric and Manufacturing Company, of Pittsburg, Pa., creditors of the Clyde Gas and Electric Company, has secured an order, from Circuit Judge Hazel, of Buffalo, requiring all parties interested to show cause, September 4th, at Buffalo, why the corporation should not be placed in involuntary bankruptcy. The corporation was formed some years ago, through the instrumentality of Lucius L. Moses, by merging the Clyde Gas Company with the Clyde Electric Company.

MR. W. D. WEST, formerly Manager for the Windsor (Ont.) Gas Company, will take charge of the plant of the Marion (O.) Gas Light Company on the 16th inst.

CONSIDERABLE damage was recently done to the Cape May (N. J.) Company's works by an explosion. The matter is referred to only for the sake of noting the speed with which the damages were repaired, the work of restoration occupying something over 5 hours.

THE Lowell (Mass.) Gas Light Company finds no trouble in readily disposing of its coke output at the satisfactory price of $4.50 per chaldron.

THE Portland (Me.) Gas Company has made a substantial contribution in cash to the fund of the Relief Association of the Police Department. The contribution was made in recognition of the valuable services rendered the Company by the police after the serious explosion that happened on the Company's works about a fortnight ago.

WE understand that much more than a controlling interest in the stock of the Olyphant (Pa.) Water Company has been purchased by the proprietors of the Scranton (Pa.) Gas and Water Company.

MR. D. TURNBOLDT has been appointed temporary Chairman of the Board of Directors of the Charleston (S. C.) Gas Company, and Mr. C. L. Lee has been chosen Secretary.

THE City Council of Oklahoma City, Oklahoma Territory, has granted a franchise for the construction of a gas works to Mr. J. B. Jones, of Chicago. Under the terms of the franchise the selling rate is put at $1.25, users of 5,000 feet or over per month to be served at $1 per 1,000. Mr. Jones estimates that his enterprise will involve an expenditure of $40,000.

SUPERINTENDENT BAKER has awarded the contracts for the betterment scheme arranged for the plants of the Wichita (Kas.) Gas, Electric Light and Power Company.

THE following proposition was submitted recently to the General Council of Louisville, Ky., by Mr. Udolpho Snead, President of the Louisville Gas Company: "As you know, this Company has been engaged in building new works on Jackson and Washington streets. It expects that these works will be fully installed shortly. As you are also aware, the Company, under an agreement with the Mayor, reduced its price of illuminating gas from $1.30 net to $1.20 on July 1st last, and is to further reduce its price to $1 net by January 1, 1905. The Louisville Gas Company proposes that, on October 1st, prox., it will reduce its price of illuminating gas to all of its customers all over the city by making a discount of 25 cents per 1,000 cubic feet, making the net price from October 1st $1 per 1,000 cubic feet. And it further proposes to agree not to advance the price above that figure so long as the city of Louisville shall not enlarge the present franchise of any other Company so as to permit the sale of gas for illuminating purposes directly or by the use of any mechanical device, nor grant to any other Company or person the right to use the streets for the distribution of natural or artificial gas for illuminating purposes directly or by the use of any mechanical device. And in case this proposal is favorably entertained the Louisville Gas Company will further agree, within one year of December 1, 1900, to extend its pipes to that part of the city called 'Parkland,' so as to be able to furnish the people residing there its gas at the same price and under the same conditions as above given. By accepting this proposition it is obvious that you will enable the people of Parkland to have gas, and make a great saving to the citizens of Louisville in the price of illuminating gas. Taking the saving accomplished by the reduction herein proposed, with that agreed to with the Mayor, it will amount to about $70,000 a year to the citizens of Louisville, or, say $315,000 between this and January 1st, 1905; and if maintained during the continuance of the charter of this Company it will effect a total saving to the people of Louisville of over one and a half millions of dollars, on the basis of the present consumers."

MR. H. R. MARCOTT, of Decatur, Ills., has been appointed Superintendent of the Pekin, Ills., works. He assumes control the 7th inst.

MR. THAD. LOWE is to manage the business interests of the Long Beach (Cal.) Gas Company. The Passadena *Star*, of recent date, says that a site for the works has been purchased and that construction contracts are being arranged by Mr. Lowe.

MR. C. H. CHRISTIE, formerly Superintendent of works, Cleveland, O., Gas Light and Coke Company, has been obliged to retire from active work because of severe illness.

THE Worcester (Mass.) Gas Light Company proposes to institute suit against the city for damages done to its mains through the negligence of those in charge of the construction of what is known in Worcester as the "new separating sewer." The Gas Company would have been satisfied to have made no complaint or claim for damages had the sewer contractors observed even the commonest sort of supervision over their work; but the Company is not prepared to lose thousands of dollars which loss would not have been incurred had the contractors been anything else than criminally negligent.

A CORRESPONDENT forwards the following, from a recent issue of the Kansas City (Mo.) *Journal*: "Mr. Hugh J. McGowan was elected President of the Kansas City, Missouri, Gas Company, at a meeting of the shareholders, especially called for the purpose. The Presidency had been made vacant by the recent death of Col. M. J. Payne, Mr. A. L. Brundrette, of Philadelphia, was elected a Director to fill the Board vacancy. Mr. McGowan has been a Director since the Company was formed by the consolidation of the Kansas City Gas Company and the Missouri Gas Company some time ago. Mr. McGowan is now President of the Indianapolis Street Railway Company, and has been spending most of his time in that city for the past several months. His elec-

(*Concluded on page 374.*)

THE AMERICAN GAS LIGHT JOURNAL

A. M. CALLENDER & CO., PROPRIETORS.

THOS. J. CUNNINGHAM, ELBERT P. CALLENDER, EDITORS.

CHAS. E. SANDERSON, MANAGER.

PUBLISHED ON EACH MONDAY OF THE YEAR AT

No. 32 Pine Street, New York.

The JOURNAL is the official organ of the
NEW ENGLAND ASSOCIATION OF GAS ENGINEERS.
AMERICAN GAS LIGHT ASSOCIATION.
WESTERN GAS ASSOCIATION.
OHIO GAS LIGHT ASSOCIATION.
PACIFIC COAST GAS ASSOCIATION.

MONDAY, SEPTEMBER 3, 1900.

(*Continued from page 373.*)

tion to the Presidency of the Gas Company will result in his spending more time in Kansas City. He continues to have his home here, at 1743 Jefferson street. He said he would be here more hereafter than he has been before since assuming the Presidency of the Indianapolis Street Railway Company. He said there would be no change in the policy of the Gas Company, and that the present office force would be continued. We think the service we are now giving is satisfactory, he said, 'and if it is not, we will make it so.' Hugh J. McGowan is a self-made man. Twenty-five years ago he came to Kansas City from his father's Clay county farm. The grasshoppers had eaten up the growing corn crop and Hugh was disgusted with farming. His first employment in Kansas City was in raking cinders from under a Wabash engine. Next he was a section hand on the Wabash, and soon after secured employment in currying mules for the street car company, his wages being fixed at $25 a month. In 1877 he was made a driver on a street car and later drove a carriage for a time, until poor health caused him to return to his father's farm, where he spent one winter attending school. He was 22 years old when he returned to Kansas City. He attended a commercial college and graduated from it, after which he drove a wagon for a furniture company, and then became a packer for the company. Finally he was given a position as car accountant for the Missouri Pacific, and a few weeks afterward was made a policeman. Mr. McGowan was on the police force six years. After five months' service he was made a sergeant and was stationed at the Union depot. There he made many important arrests and left with the record of having never arrested the wrong man. In 1886, after a hard fight in the convention, Mr. McGowan was given the Democratic nomination for county marshal. He spent only $300 in the campaign and was elected. It was during his term as county marshal that he had his first use for a bank. Mr. McGowan could have held the office for a second term, but he had tired of politics. He wanted to engage in commercial life, and he made several ventures that were successful. In 1890 he became the Kansas City agent of the Barber Asphalt Company. At that time the city had 70,000 yards of street pavement. To-day it ranks in this respect as the third city in the world. Buffalo is the first, New York second and Kansas City third. When the gas companies of Kansas City were consolidated Mr. McGowan was an important factor in the deal. He earned the respect and confidence of Eastern promoters by his work, and when the plan was hatched to consolidate the street railways of Indianapolis he was selected to conduct the negotiations. He went to Indianapolis last December. He found the proposition a hard one, but a very good one. Finally, after a good deal of work and admirable financiering, he brought about the consolidation of the 125 miles of street car lines in Indianapolis into one big system with a capital of $15,000,000."

MR. WILLIAM A. DUFFIELD, President of the City Gas Company, of London, Ont., died, the morning of August 20th, at the residence of his mother, Mrs. William Duffield, 517 Queen's avenue, London. Mr. Duffield's death was due to a severe attack of typhoid fever, from which he had been suffering for some time. He had not been in the best of health for a couple of months, and six weeks ago he took a course at the baths at Mount Clemens, Mich., which, however, failed to improve his health. William Alexander Duffield was born in London, March 19th, 1861, and was the son of the late Mr. William Duffield, whose death occurred, Dec. 25, 1899. He spent all his life in London, taking from the beginning of his business career an active interest in the affairs of the City Gas Company, to the Presidency of which he was elected after his father's death. He was unmarried, and in his death London loses a useful, progressive and estimable citizen.

THE Union Light and Heat Company, of Cincinnati, O., has been chartered in Dover, Del., with a capital of $200,000. It is rather a mysterious affair, although its avowed purpose is to "install gas works for lighting cities and towns."

THE improvements on the plant of the Winsted (Conn) Gas Company will be completed by November 15th.

The Market for Gas Securities.

The city gas share market was without particular feature during the week, although quite some business was done in Consolidated, the high point therein having been a trifle over 175. To-day (Friday) the closing was 174½ to 174¾. This is virtually ex-dividend for the quarter, payable September 15th. The dividend was declared to-day, and the "proprietors" saw fit to restore it to the rate which prevailed prior to the gas war commenced in 1899; that is, 2 per cent. for the last quarter. The persons who exchanged their shares in the city electric concerns for shares in the Consolidated Company participate in the current distribution. Mutual is firmly held at something above 300. All bonds that underlie any concerns which are guaranteed by the Consolidated Company are in good demand.

Brookly Union is lifeless, as far as actual transfers are for record, but quotations show no change. They will, though, before Jan. 1st, with the difference on the high grade. Peoples, of Chicago, is inclined to weakness over pettifogging stories connected with the starting of an opposition company there. Consolidated, of Baltimore, is going on safely to a higher level. Bay State is one, or thereabouts. The general market conditions are favorable to holders.

Gas Stocks.

Quotations by George W. Close, Broker and Dealer in Gas Stocks.

16 WALL STREET, NEW YORK CITY.

SEPT. 3.

☞ All communications will receive particular attention.

☞ The following quotations are based on the par value of $100 per share.

N. Y. City Companies.	*Capital.*	*Par.*	*Bid.*	*Asked.*
Consolidated—Ex rights	$4,595,200	100	174	174½
Central Union, Bonds, 5's.	3,000,000	1,000	103½	105
Equitable Bonds, 6's	1,000,000	1,000	105	..
" 1st Con. 5's	2,300,000	1,000	120	..
Metropolitan Bonds	658,000	..	108	113
Mutual	3,500,000	100	305	320
" Bonds	1,500,000	1,000	100	102
Municipal Bonds	750,000	.	..	.
New Amsterdam Gas Co. ..				
Bonds, 5's	11,000,000	1,000	105	106½
Northern Union, Bonds, 5's.	1,250,000	1,000	102	103
New York and East River..				
Bonds 1st 5's	3,500,000	1,000	105	106½
" 1st Con. 5's	1,500,000	..	115	..
Richmond Co., S. I.	348,650	50	70	..
" Bonds	100,000	1,000	..	..
Standard	5,000,000	100	121	125
Preferred	5,000,000	100	141	145
Bonds, 1st Mortgage, 5's	1,500,000	1,000	115	114
Yonkers	299,620	500	130	..
Out-of-Town Companies.				
Brooklyn Union	15,000,000	100	167	174
" " Bonds (5's)	15 000,000	1,000	115	119
Bay State	50,000,000	50	1	1½
" Income Bonds	2,000,000	1,000	..	75
Binghamton Gas Works	450,000	100	23½	30
" 1st Mtg. 5's	475,000	1,000	96½	99½
Boston United Gas Co.—				
1st Series S. F. Trust	7,000,000	1,000	82	85
2d " " "	3,000,000	1,000	47½	50
Buffalo City Gas Co.	5,500,000	100	4	5½
" " Bonds, 5's	5,250,000	1,000	64	67
Capital, Sacramento	500,000	50	..	35
Bonds (6's)	150,000	1,000	..	..
Central San Francisco	2,000,000	..	106	108
Chicago Gas Co. Guaranteed Gold Bonds	7,650,000	1,000	104	104½
Cincinnati G. & C. Co.	8,500,000	100	199¾	201
Columbus (O.) Gas Co., 1st Mortgage Bonds	1,207,000	1,000	106	107
Columbus (O.) Gas Lt. & Heating Co	1,682,700	100	60	65
Preferred	3,026,500	100	84	86
Consumers, Jersey City Bonds	600,000	1,000	102	105
Consumers, Toronto	1,700,000	50	230	235
Consolidated, Baltimore	11,000,000	100	56½	57½
Mortgage, 6's	3,600,000	..	..	118
Chesapeake, 1st 6's	1,000,000	..	..	..
Equitable, 1st 6's	910,000	..	..	..
Consolidated, 1st 5's	1,490 000	..	..	112
Consolidated Gas Co. of N.J.	1,000,000	100	12½	15
" Con. Mtg. 5's	880,000	1,000	82	86
Consolidated G. & E. Co.'s, Little Falls, N.Y.	90,000	100	..	100
Bonds	75,000	..	..	100
Detroit City Gas Co.	4,560,000	50	95	97
" Prior Lien 5's	4,598,000	1,000	99¼	100
Detroit Gas Co., 5's	386,000	1,000	100	101
" Inc. 5's	16,000	100	94	94½
Equitable Gas & Fuel Co., Chicago, Bonds	2,000,000	1,000	..	101
Essex and Hudson Gas Co.	6,500,000	..	35	40
Fort Wayne	2,000,000	..	35	41
Bonds	3,000,000	..	60	64
Grand Rapids Gas Lt. Co..	1,000,000	50	..	..
" 1st Mtg. 5's	1,125,000	1,000	..	..
Hartford	750,000	25	..	230
Hudson County Gas Co., of New Jersey	10,500,000	..	25	..
" Bonds, 5's	10,500,000	..	101	103
Indianapolis	2,000,000	..	70	80
" Bonds, 6's	2 650,000	..	100	104
Jackson Gas Co.	250,000	50	70	75
" 1st Mtg. 5's	250,000	1,000	101	102½
Kansas City Gas Light Co., of Missouri	5,000,000	100	..	36
Bonds, 1st 5's	3,822,000	1,000	101½	103
Laclede, St. Louis	7,500,000	100	73	75
Preferred	2,500,000	100	98	100
Bonds	10,000,000	1,000	110	110½

Lafayette Gas Co., Ind.	1,000,000	100	35	40
Bonds	1,000,000	1,000	60	65
Louisville	2,570,000	50	110	120
Madison Gas & Elec. Co.	400,000	100	70	75
" 1st Mtg. 6's	350,000	1,000	102½	108
Montreal, Canada	2,000,000	100	182	184½
Newark, N. J., Con. Gas Co	6,000,000	..	..	55
Bonds, 6's	4,600,000	..	..	108
New Haven	1,000,000	25	280	300
Nashville Gas Lt. Co.	1,000,000	50	110	..
Oakland, Cal.	2,800,000	..	46	47
" Bonds	750,000	..	..	..
Peoples G. L. & Coke Co., of Chicago	25,000,000	100	93½	95½
Peoples Gas Lt. & Coke Co., Chicago, 1st Mortgage	20,100,000	1,000	111⅛	111½x
2d "	2,500,000	1,000	104	105
Rochester Gas & Elec. Co.	2,150,000	50	88	..
Preferred	2,150,000	50	118	..
Consolidated 5's	2,000,000	..	87½	90
San Francisco, Cal.	10,000,000	100	47¼	47½
St. Paul Gas Light Co.	1,500,000	100	49¼	53
1st Mortgage 6's	650,000	1,000	82	85
Extension, 6's	600,000	1,000	..	..
General Mortgage, 5's	2,425,000	1,000	88	90½
St. Joseph Gas Co.	1,000,000	100	30	34
" 1st Mtg. 5's	750,000	1,000	96½	98
Syracuse, N. Y.	1,750,000	100		15
Bonds	1,612 000	1,000	88½	93
Washington, D. C	2,500,000	20	270	271
First mortgage 6's	600,000	..	..	..
Western, Milwaukee	4,000,000	100	95	98
Bonds, 5's	3,880,500	.	104	106
Wilmington, Del.	600,000	50	200	210

Advertisers' Index.

GAS ENGINEERS.

Page

Wm. Henry White, New York City ... 395
Fred. Bredel, Milwaukee, Wis. ... 382
Geo. R. Rowland, New York City ... 393
The Western Gas Construction Co., Fort Wayne, Ind. ... 360
Humphreys & Glasgow, New York City ... 393
American Gas Co., Phila., Pa. ... 382
David Leavitt Hough, New York City ... 392
Economical Gas Apparatus Construct'n Co., Toronto, Ont. ... 379
Baxter & Young, Detroit, Mich. ... 394
United Gas Improvement Co., Phila., Pa ... 387
James T. Lynn, Detroit, Mich. ... 392
A. E. Boardman, Brevard, N. C. ... 392

GAS WORKS APPARATUS AND CONSTRUCTION.

Continental Iron Works, Brooklyn, N. Y. ... 394
Deily & Fowler, Phila., Pa. ... 396
Kerr Murray Mfg. Co., Fort Wayne, Ind ... 392
Stacey Mfg. Co., Cincinnati, Ohio ... 395
Bartlett, Hayward & Co., Baltimore, Md. ... 393
Davis and Farnum Mfg. Co., Waltham, Mass. ... 392
R. D. Wood & Co., Phila., Pa. ... 394
Isbell-Porter Company, New York City ... 394
Fred. Bredel, Milwaukee, Wis. ... 382
United Gas Improvement Co., Phila., Pa ... 387
National Gas and Water Co., Chicago, Ills ... 389
Economical Gas Apparatus Construct'n Co., Toronto, Ont. ... 379
The Western Gas Construction Co., Fort Wayne, Ind. ... 360
Humphreys & Glasgow, New York City ... 393
American Gas Co., Phila., Pa. ... 382
Logan Iron Works, Brooklyn, N. Y. ... 396
Riter-Conley Mfg. Co., Pittsburgh, Pa. ... 395
Baxter & Young, Detroit, Mich. ... 392
American Bridge Co., New York City ... 378
G. Shepard Page's Sons, New York City ... 392
James T. Lynn, Detroit, Mich. ... 392
A. E. Boardman, Brevard, N. C. ... 392
Sutherland Construction & Improvement Co., N. Y. City ... 379
Chris. Cunningham & Son, Brooklyn, N.Y. ... 394

PROCESSES.

Bartlett, Hayward & Co., Baltimore, Md. ... 393
United Gas Improvement Co., Phila., Pa. ... 387
Burdett Loomis, Hartford, Conn. ... 394
National Gas and Water Co., Chicago, Ills. ... 389
Economical Gas Apparatus Construct'n Co., Toronto, Ont. ... 379
The Western Gas Construction Co., Fort Wayne, Ind. ... 360
Humphreys & Glasgow, New York City ... 393
Sutherland Construction & Improvement Co., N. Y. City ... 379
B. E. Chollar, St. Louis, Mo. ... 378

SCRUBBERS AND CONDENSERS.

R. D. Wood & Co., Phila., Pa. ... 394
Continental Iron Works, Brooklyn, N. Y. ... 394
Logan Iron Works, Brooklyn, N. Y. ... 396
Riter-Conley Mfg. Co., Pittsburgh, Pa. ... 395

TAR AND CARBONIC ACID EXTRACTOR.

R. D. Wood & Co., Phila., Pa. ... 394

AMMONIA CONCENTRATORS.

Michigan Ammonia Works, Detroit, Mich. ... 376
American Gas Company, Phila., Pa. ... 386

GAS METERS.

John J. Griffin & Co., Phila., Pa. ... 400
American Meter Co., New York and Philadelphia. ... 399
Helme & McIlhenny, Phila., Pa. ... 399
D. McDonald & Co., Albany, N.Y. ... 397
Nathaniel Tufts Meter Co., Boston, Mass. ... 398
Maryland Meter and Mfg. Co., Baltimore, Md. ... 398
Metric Metal Co., Erie, Pa. ... 399
Keystone Meter Co., Royersford, Pa. ... 398
Detroit Meter Company, Detroit, Mich. ... 399

PREPAYMENT METERS.

American Meter Co., New York and Philadelphia. ... 399
John J. Griffin & Co., Phila., Pa. ... 400
D. McDonald & Co., Albany, N.Y. ... 397
Helme & McIlhenny, Phila., Pa. ... 399
Nathaniel Tufts Meter Co., Boston, Mass. ... 398

GAS AND WATER PIPES.

M. J. Drummond & Co., New York City ... 384
R. D. Wood & Co., Phila., Pa. ... 394
Warren Foundry and Machine Co., New York City ... 384
Donaldson Iron Co., Emaus, Pa. ... 384
Chris. Cunningham & Son, Brooklyn, N.Y. ... 384
Cornell & Underhill, New York City ... 384
Charles Millar & Son Co., Utica, N. Y. ... 384

GAS MAIN STOPPERS.

Safety Gas Main Stopper Co., N. Y. City ... 381

GAS TAPPING MACHINES.

George Light, Dayton, O. ... 377
H. Mueller Manufacturing Company, Decatur, Ills. ... 377

FLEXIBLE JOINTS.

Campbell Mfg. Co., Stamford, Conn. ... 396

STEAM BLOWER FOR BURNING BREEZE.

H. E. Parson, Brooklyn, N. Y. ... 389

GAS COALS.

Penn Gas Coal ... 391
Perkins & Co., New York City ... 390
Despard Gas Coal Co., Baltimore, Md. ... 391
Westmoreland Coal Co., Phila., Pa. ... 391
Berwind-White Coal Mining Co., New York and Phila. ... 390

CANNEL COALS.

Perkins & Co., New York City ... 390
Greasy Creek Cannel Coal and Tramway Co., Chicago. ... 376

CONVEYORS.

The Link-Belt Machinery Co., Chicago, Ills. ... 381

GAS ENRICHERS.

Standard Oil Co., New York City ... 391
The Sun Oil Co., Pittsburgh, Pa. ... 391

COKE CRUSHER.

C. M. Keller, Columbus, Ind. ... 391

GAS GAUGES.

The Bristol Co., Waterbury, Conn. ... 376

GAS GOVERNORS.

Connelly Iron Sponge and Governor Co., New York City ... 389
Isbell-Porter Co., New York City ... 394
R. D. Wood & Co., Phila., Pa. ... 394
Wm M. Crane Co., New York City ... 377

CEMENTS.

C. L. Gerould, Galesburg, Ills ... 383

RETORTS AND FIREBRICKS.

J. H. Gautier & Co., Jersey City, N. J. ... 398
Adam Weber, New York City ... 388
Laclede Firebrick Mfg. Co., St. Louis, Mo. ... 398
Cyrus Borgner, Phila., Pa. ... 388
James Gardner, Jr., Co., Pittsburgh, Pa. ... 386
Henry Maurer & Son, New York City ... 398
Baltimore Retort and Firebrick Co., Baltimore, Md. ... 389
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. ... 386
Brooklyn Firebrick Works, Brooklyn, N. Y. ... 388
Missouri Firebrick Co., St. Louis, Mo. ... 386

REGENERATIVE FURNACES.

Bartlett, Hayward & Co., Baltimore, Md. ... 393
Fred. Bredel, Milwaukee, Wis. ... 382
J. H. Gautier & Co., Jersey City, N. J. ... 398
Parker-Russell Mining and Mfg. Co., St. Louis, Mo. ... 388
Adam Weber, New York City ... 388
Missouri Firebrick Co., St. Louis, Mo. ... 388

SELF-SEALING MOUTHPIECE DOORS.

Isbell-Porter Co., New York City ... 394
Continental Iron Works, Brooklyn, N.Y. ... 394
Logan Iron Works, Brooklyn, N. Y. ... 396
R. D. Wood & Co., Phila., Pa. ... 394

INCANDESCENT GAS LAMPS.

Welsbach Company, Gloucester, N.J. ... 384
Kern Incandescent Gas Light Co., New York City.. 380 381

BURNERS.

C. A. Gefrorer, Phila., Pa. ... 394
Wm. M. Crane Co., New York City ... 391
D. M. Steward Mfg. Co., Chattanooga, Tenn. ... 381

LAVA GAS TIPS.

D. M. Steward Mfg. Co., Chattanooga, Tenn ... 381

STREET LAMPS.

Welsbach Street Lighting Co., New York and Phila. ... 386
Thos T. W. Miner, New York City ... 377

PURIFIERS.

Stacey Mfg. Co., Cincinnati, O. ... 378

PURIFYING MATERIALS.

Connelly Iron Sponge and Governor Co., New York City 389

VALVES.

Ludlow Valve Manufacturing Co., Troy, N.Y. ... 376
Chapman Valve Manufacturing Co., Boston, Mass. ... 376
R. D. Wood & Co., Phila., Pa. ... 394
Continental Iron Works, Brooklyn, N. Y. ... 394
The P. H. & F. M. Roots Co., Connersville, Ind. ... 383
Isbell-Porter Co., New York City ... 394
The Western Gas Construction Co., Fort Wayne Ind. ... 360
Kerr Murray Mfg. Co., Fort Wayne, Ind. ... 392

EXHAUSTERS.

The P. H. & F. M. Roots Co., Connersville, Ind. ... 383
Isbell-Porter Company, New York City ... 394
Connelly Iron Sponge and Governor Co., New York City 389
Kerr Murray Mfg. Co., Fort Wayne, Ind. ... 392

ELECTRICAL APPARATUS.

Wm. Henry White, New York City ... 395

ENGINES AND BOILERS.

The Hazelton Boiler Company, New York City ... 377

PURIFIER SCREENS.

John Cabot, New York City ... 376

GAS STOVES.

American Meter Co., New York and Philadelphia. ... 385
Maryland Meter and Manufacturing Co., Baltimore, Md. ... 394
Keystone Meter Co., Royersford, Pa. ... 394
Nathaniel Tufts Meter Co., Boston Mass. ... 393
Wm. M. Crane Co., New York City ... 377

HOT WATER HEATERS.

Wm. M. Crane Co., New York City ... 377

GASHOLDER TANKS.

J. P. Whittier, Brooklyn, N. Y. ... 393

GASHOLDERS.

Bartlett, Hayward & Co., Baltimore, Md. ... 393
Continental Iron Works, Brooklyn, N. Y. ... 394
Deily & Fowler, Philadelphia, Pa. ... 396
Davis & Farnum Mfg. Co., Waltham, Mass. ... 392
Kerr Murray Mfg. Co., Fort Wayne, Ind. ... 392
Stacey Mfg. Co., Cincinnati, Ohio ... 395
R. D. Wood & Co., Philadelphia, Pa. ... 394
Logan Iron Works, Brooklyn, N. Y. ... 396
Riter-Conley Mfg. Co., Pittsburgh, Pa. ... 395

STORAGE TANKS.

Chris. Cunningham & Son, Brooklyn, N.Y. ... 394

GAS SECURITIES.

Henry Marquand & Co., New York City ... 376

ADVERTISING.

J. Howland Harding, New York City ... 376

BOOKS, ETC.

Newbigging's Handbook	397
Field's Analysis, 1899	395
Scientific Books	399
Digest of Gas Cases	391
Practical Photometry	394
Gas Flow Computers	398
Hughes' "Gas Works"	389
Gas Engineer's Pocket-Book	394
Excerpts from Reports of Gas Commissioners	399
Binders	384
Directory of Gas Companies	395
Practical Handbook on Gas Engines	397
Coal Tar Tree	378
Poole on Fuels	356

POSITION WANTED

As Foreman of a Gas Plant,

By an all around man, thoroughly experienced in either coal or water gas, in a plant sending out not less than 50,000,000 cubic feet per annum. Best references.

Address "C. D.,"
1317-1 407 Wisconsin St., Kenosha, Wis.

Position Wanted

By a Man who is not Afraid of Hard Work.

Has had 20 years' experience in all the departments—manufacturing, distribution, new business and office work.

Address "W.,"
1296-tf Care this Journal.

Position Wanted

As Manager or Engineer of a Gas Company.

Thoroughly Competent Gas Manager of many years' experience in the manufacturing and the executive ends of a Gas Company desires a position as Manager or Engineer of a Gas Company selling not less than 50,000,000 cubic feet per annum. Highest references given. Address "T."
1267-tf Care this Journal.

FOR SALE,

SECOND-HAND MATERIAL.

One second-hand 6-inch Dry Center Seal, complete, in good order, with all elbows to connect to boxes.

One second-hand 4-foot Station Meter, with iron stand. Meter needs new face and gear.

One second-hand 40-horse power Gas Engine in running order. Made by Crossley Bros., Manchester, England.

Apply to STANDARD GAS AND ELECTRIC CO.,
1314-4 Raleigh, N. C.

FOR SALE.

PURIFIERS.

Two 8 by 10 purifiers, with 8-inch center seal and connections. Center seal made for four purifiers. All in good condition.

Address C. M. KELLER,
1312-tf Columbus, Ind.

FOR SALE,

A New Condenser and Scrubber,

Each 11 feet 6 inches high, 3 feet in diameter, inside measurement, and 6-inch connections—all connections reinforced. Two manholes to scrubber, with two sets of trays; also one 6-inch center valve. These have never been used.

Address FEEKSKILL GAS LIGHT COMPANY,
1300-tf Peekskill, N. Y.

For Sale.

A Small Gas and Electric Light Plant,

in a Southern city of 3,800 inhabitants.

Address FORT WAYNE ELECTRIC CORPORATION,
1097-tf Fort Wayne, Ind.

Utilize Your Gas Liquor.

NO EXTRA LABOR OR OPERATING EXPENSES.

Ammonia Concentrator.

Not Expensive. Write to STROH & OSIUS, Pat'ees, or Mich. Ammonia Works, Detroit, Mich.

Practical Photometry.

By William Joseph Dibdin.

Price, $3.00.

A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY

PLANS ADVICE WRITING ILLUSTRATING

J. ROWLAND HARDING, ADVERTISING, 1545 BROADWAY, LONG ACRE SQUARE NEW YORK

TRAYS FOR GAS WORKS

JOHN CABOT

533/537 W. 35th ST. NEW YORK

Circulars and Prices on Application.

HENRY MARQUAND & CO.,

BANKERS AND BROKERS.

160 Broadway, New York City.

Bristol's Recording

PRESSURE GAUGE.

For continuous records of **Street Gas Pressure.** Simple in construction, accurate in operation, and low in price.

Fully Guaranteed. Send for Circulars.

THE BRISTOL CO.,
Waterbury, Conn.

KENTUCKY CANNEL COAL, FOR GAS AND DOMESTIC USE

GEO. R. HISLOP, F.C.S., F.R.S.S.A., Gas Engineer of Paisley, Scotland, says in his analysis: "This is a remarkably rich Cannel Coal, yielding illuminating matter per ton equivalent to 1,945 lbs. of sperm candles." This coal mined and shipped in box cars. Write for sample car and delivered price.

The Greasy Creek Cannel Coal and Tramway Co.,

163 WEST WASHINGTON STREET, CHICAGO, ILLS.

CHAPMAN VALVE MANUFACTURING CO.

MANUFACTURERS OF

Valves and Gates for Gas, Ammonia, Water, Etc.

Also, Gate Fire Hydrants with and without Independent Nozzle Valve. All Work Guaranteed.

Works & Gen'l Office, Indian Orchard, Mass. Treasurer's Office, 72 Kilby & 112 Milk Sts., Boston, Mass.
Chicago Office, 24 West Lake St. New York Office, 28 Platt St.
St. Louis Office, L. M. Rumsey Mfg. Co., 810 North Second St.

THE

Ludlow Valve Mfg. Co.,

TROY, N. Y., U. S. A.

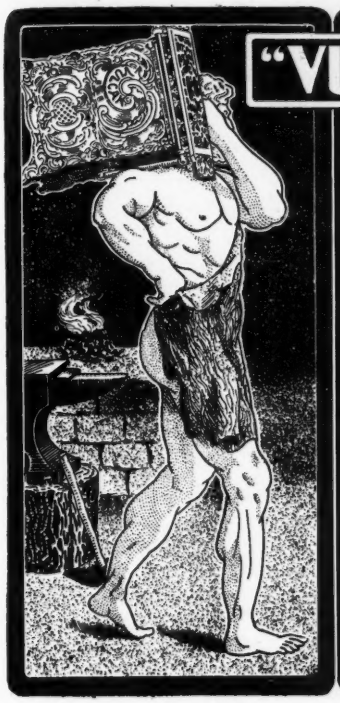
Double and Single Gate Valves, ¼" to 72",

—FOR—

Gas, Water, Steam, Oil, Ammonia, Etc.

HOT GAS VALVES A SPECIALTY.

Send for Catalogue.



"VULCAN" GAS APPLIANCES

The "Vulcan" Perforated Gas Radiators.

Our line of perforated heaters in various styles has proved most efficient and satisfactory in every way. They were introduced by us and are manufactured under patents which we control.

We are introducing this fall a new Perforated Radiator, made in three sizes. Order samples, test them and you will order this style and no other.

With Gas Heaters it is of the utmost importance to have Fittings and Tubing with large gas way and of the best quality. We sell no other.

William M. Crane Company,

FOUNDRY: PEEKSKILL, N. Y. 1131-1133 Broadway, New York.

"THE MINER"

Globe Street and Boulevard Lamps.

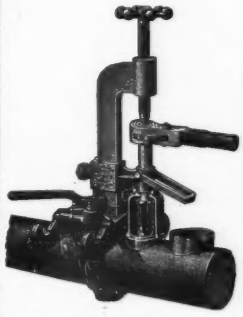
Cheapest and Best.

THOUSANDS IN USE WITH INCANDESCENT BURNERS.

Send for Catalogues.

THOMAS T. W. MINER,

821-823 Eagle Av., N.Y.



Special Attachment, B-109.

MUELLER

Gas Tapping Machines.

If you have the satisfaction of knowing that the taps your men make are made in the easiest and best manner, and that they stay good, we know you are using a Mueller Machine.

CATALOGUES AND DISCOUNTS FROM

H. MUELLER MFG. COMPANY,

DECATUR, ILLS.

GAS TAPPING MACHINES

—FOR—

Drilling and Tapping Pipe under Pressure

WITHOUT ANY ESCAPE OF GAS.

They are Strong and Compact.

Size of Combination Drills and Taps ¾ to 4-inch.

Machines Sent to any Gas Company for Thirty Days' Trial.

Send for Circulars.

Geo. Light,

DAYTON, O.

Hazelton Water HIGH PRESSURE.

The Pioneer Vertical Water-Tube Boiler of the World.

Over 11½ Square Feet of Heating Surface per Horse Power.

High Quality and Durability of the Tubes the Most Vital Part of a Boiler.

Fastened at One End Only, Expand and Contract Without Strain, Averting any Possibility of Leakage.

The HAZELTON BOILER CO.

SOLE PROPRIETORS AND MANUFACTURERS,

Tube Boilers.

Boilers we Built have been in Constant Use 18 Years, and are in Operation To-day with Fine Results.

10 to 25 Per Cent. Guaranteed Over Other Boilers

Strong, Natural, Upright Draft, Consuming All Kinds of Fuel. Absolutely Dry Steam.

Small Floor Space, Less per Horse Power than for Any Other Boiler.

120 Liberty St., N.Y. Telephone, 4194 Cortlandt

Cable Address, "Pails," N. Y.

AMERICAN BRIDGE CO.,

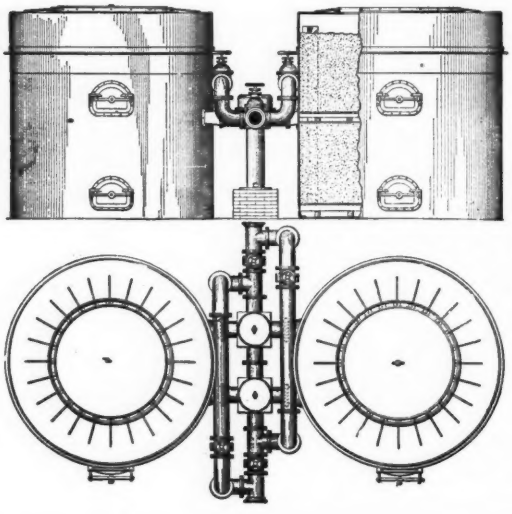
Designers and Builders of Steel Bridges, Steel Buildings and All Classes of Metallic Structures.

GENERAL OFFICES.

No. 100 Broadway, New York.

BRANCH OFFICES.

Boston, Philadelphia, Chicago,
Pittsburg, Baltimore,
New Orleans, Cleveland, Minneapolis.



CHOLLAR'S SYSTEM OF GAS PURIFICATION.

Covered by Five U.S. Patents.

In operation, revivification of the oxide is effected by repeated reversals of the direction of the flow of the gas through the beds (in the two boxes used under this system there are eight different routes for the gas to take) whereby the purified gas is made to revive the oxide in parts of the apparatus while the foul gas is fouling it in others.

The boxes are charged or discharged from the sides as well as the top.

There are no Hydraulic Cups or heavy covers.

Either end of the apparatus is inlet or outlet at pleasure.

The capacity is increased five-fold or more over ordinary methods without addition to building.

The apparatus costs less than for any other system.

For Estimates Write **The Stacey Mfg. Co.,**
SOLE MANUFACTURERS,
FOR FURTHER INFORMATION WRITE **CINCINNATI, OHIO.**
B. E. CHOLLAR, 411 N. 11th St., St. Louis, Mo.

Coal Tar Genealogical Tree.

Mr. T. Viner Clarke, of London, Eng., having compiled a novel Chart or Map illustrating the various CHEMICAL PRODUCTS DERIVED FROM COAL AND COAL TAR, in the form of a Genealogical Tree, including all the products discovered (the total number amounting to near 700), offers for sale a limited number of copies in Colors, mounted on Linen, with Rollers. Price, $3.50. Orders may be sent to

A. M. CALLENDER & CO., No. 32 Pine Street, New York.

W. H. PEARSON, Prest. W. H. PEARSON, Jr., Vice-President. J. T. WESTCOTT, M.E., Manager. L. L. MERRIFIELD, M.Inst.M.E., Chief Engineer.

THE ECONOMICAL GAS APPARATUS CONSTRUCTION CO., LD.

American Offices: 269 FRONT STREET, EAST, TORONTO, ONT.

London Offices: 19 ABINGDON STREET, WESTMINSTER, S.W.

Telegraphic Address: "CARBURETED LONDON AND TORONTO."

The above Company have erected since 1893, or are now erecting, their universal type of Carbureted Water Gas Plants at the following Gas Works:

	Cubic Feet Daily.
Blackburn, England	1,250,000
Windsor Street Works, Birmingham, England	2,000,000
Saltley Works, Birmingham, England	2,000,000
Colchester, England	300,000
Birkenhead, England	2,250,000
Swindon (New Swindon Gas Company), England	120,000
Saltley Works, Birmingham, England (Second Contract)	2,000,000
Windsor Street Works, Birmingham, England (Second Contract)	2,000,000
Halifax, England	1,000,000
Toronto	250,000
Ottawa	250,000
Toronto (Second Contract, Remodeled)	2,000,000
Lindsay (Remodeled)	125,000
Belleville	250,000
Ottawa (Second Contract)	250,000
Brantford (Remodeled)	200,000
St. Catherine's (Remodeled)	250,000
Kingston, Pa.	125,000
Montreal	500,000
Peterborough, Ont.	250,000
Wilkesbarre, Pa.	750,000
St. Catherine's (Second Contract)	250,000

	Cubic Feet Daily.
Buffalo, N. Y.	2,000,000
Winnipeg, Man.	500,000
Colchester, England (Second Contract)	300,000
York, England	750,000
Rochester, England	500,000
Kingston, Ont.	300,000
Crystal Palace District, England	2,000,000
Duluth, Minn.	300,000
Caterham, England	150,000
Enschede, Holland	150,000
Leicester, England	2,000,000
Buenos Ayres (River Platte Co.)	700,000
Burnley, England	1,500,000
Kingston-on-Thames, England	1,750,000
Accrington, England	500,000
Tonbridge, England	300,000
Stretford, England	500,000
Oldbury, England	300,000
Saltley Works, Birmingham, England (Third Contract)	2,000,000
York, England (Second Contract)	750,000
Rochester, England (Second Contract)	500,000
Newport, Monmouth, England	250,000

Sutherland Construction & Improvement Co.

Offices: 15 WALL ST., NEW YORK, and OSHKOSH, WISCONSIN.

Owners of the "SUTHERLAND" Patents for Water Gas Apparatus.

Gas, Electric Light, Water Works, and Electric Street Railways Built, Remodeled, Operated, Bought and Sold.

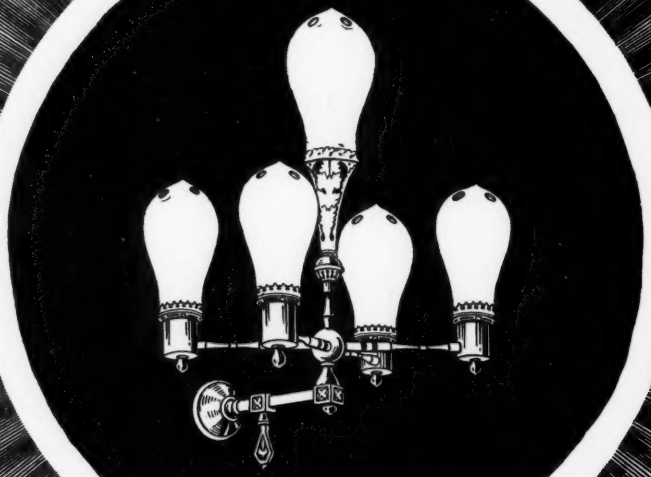
A few of the places where the SUTHERLAND Apparatus is in successful operation:

Ilion, N. Y.
Herkimer, N. Y., 2 orders.
Little Falls, N. Y.
Fishkill-on-Hudson, 2 orders.
Clifton Springs, N.Y., 2 orders.
Green Bay, Wis.
Stevens Point, Wis.
Tarrytown, N.Y., 3 orders.
Ft. Henry, N. Y.
Gainsville, Fla.
Hollidaysburg, Pa.
Waterville, N. Y.
Huntington, L. I.
Lexington, Mo.
Mendota, Ill.
Circleville, O.
Joplin, Mo.
Ashville, N. C.
Youngstown, O.
Kingston & Rondout, N. Y.

CORRESPONDENCE SOLICITED.

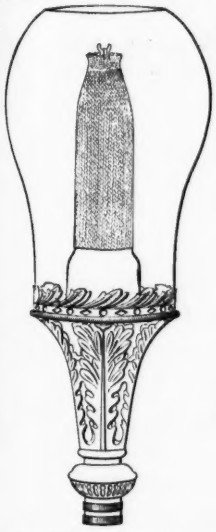
KERN

INCANDESCENT GAS LIGHT CO.



18 MURRAY ST.

NEW YORK.



Kern Incandescent Gas Light Company's Systems.

NO CHIMNEY. NO BREAKING GLASS.
NO BLACKENED MANTLES.

CAN BE USED WITH

Manufactured Gas, Non-Carburetted Gas, Natural Gas or Gasoline Gas.

35 TO 40 CANDLES PER CUBIC FOOT.

Burner No.	0	consumes	8/10	cu. ft.	.	30-candle power.	Burner No.	3	consumes	3	cu. ft. . 105 candle power.
"	1	"	1	"	.	35 " "	"	4	"	4	" . 140 " "
"	2	"	2	"	.	70 " "	"	7	"	7	" . 225 " "

Prices Reasonable. Catalogues on Application. Agents Wanted.

KERN INCANDESCENT GAS LIGHT COMPANY,
18 MURRAY STREET, NEW YORK.

Steward Burners.

Closest Attention to **Durability, Candle Power, Finished Appearance.**

Samples to be Had for the Asking.

Write for neat vest pocket memorandum book. Sent Free.

The D. M. Steward Mfg. Co.,

New York Office, 107 CHAMBERS ST. CHATTANOOGA, Tenn.

BRAY BURNERS.

WILLIAM M. CRANE COMPANY,
SOLE AGENTS FOR UNITED STATES,
1131-1133 Broadway, New York.

THE THOMAS DAY COMPANY,
Distributing Agents for Pacific Coast,
San Francisco, Cal.

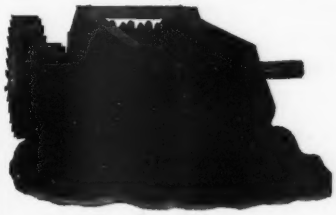
SAFETY GAS MAIN STOPPER CO.

108 EAST 117TH ST., N. Y.

FOR SHUTTING OFF GAS IN MAINS TEMPORARILY DURING ALTERATIONS AND REPAIRS

THE LINK-BELT MACHINERY CO.,

ENGINEERS, FOUNDERS, MACHINISTS,
Chicago, U. S. A.



"Link-Belt" Breaker.

LINK-BELT ELEVATING & CONVEYING MACHINERY for HANDLING COAL, COKE, OXIDE, ETC.

Tilting Coal and Coke Cars, Breaker Rolls, Shaking Screens, Power Transmitting Machinery.

Machinery designed and erected to suit existing conditions and available space.

CATALOGUE UPON APPLICATION

AMERICAN GAS COMPANY

Constructors of Coal Gas Apparatus.

EASTERN AGENTS FOR

BREDEL'S SYSTEM
COAL GAS PLANTS AND GAS APPARATUS.

P. H. & F. M. ROOTS CO.'S
Exhausters, Governors, etc.

GENERAL AGENTS FOR

BRONDER'S CHARGING AND DISCHARGING MACHINES.

AMERICAN GAS COMPANY,

222 South Third Street, Philadelphia, Pa.

FRED. BREDEL, C.E.

Coal and Water Gas Plants.

OWN SYSTEM.

RECUPERATIVE FURNACES, WASHERS, CONDENSERS, PURIFIERS, PURIFYING MACHINES, COKE CONVEYERS, ETC.

SOLE UNITED STATES AGENT FOR
ARROL-FOULIS MECHANICAL CHARGING AND DRAWING MACHINES.

Gas Enriching Plants to Enrich Coal Gas up to 24 Candle Power, and Making a White, Bright, Non-smoking Gas.

GAS RETORTS AND SPECIAL BLOCKS AND FIREBRICK MANUFACTURED UNDER THE SUPERINTENDENCE OF MY OWN CHEMIST.

COMPLETE GAS WORKS

No. 118 Farwell Avenue, · Milwaukee, Wis.

Eastern Agents: AMERICAN GAS CO., Construction Department, 222 So. 3d St., Phila., Pa.

ROOTS'

LATEST IMPROVED GAS EXHAUSTER

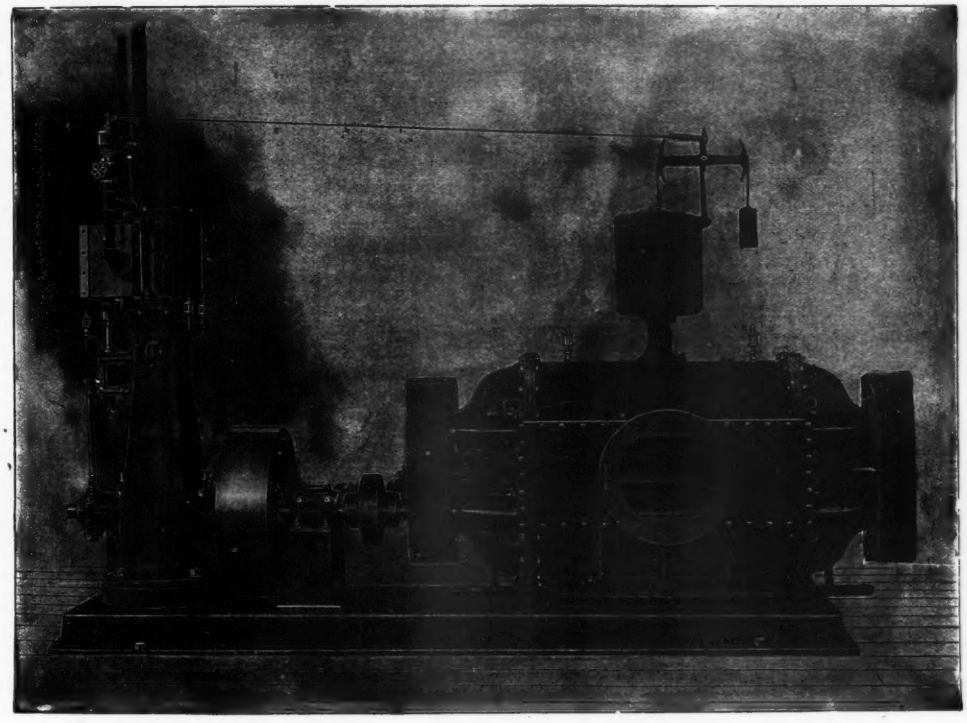
—AND—

NEW GAS GOVERNOR AND STEAM VALVE.

GUARANTEED TO REGULATE WITHIN ONE-TENTH OF AN INCH, WATER PRESSURE.

The Most Perfect Gas Governor on the Market.

MORE DIRECT IN ACTION. FEWER PARTS.
EASIER TO ADJUST THAN ANY OTHER GOVERNOR.



INQUIRIES CHEERFULLY ANSWERED. WRITE FOR CATALOGUE.

P. H. & F. M. ROOTS CO.,

Connersville, Ind. 109 Liberty St., New York.

Eastern Office:

American Gas Company,

222 South Third Street, Philadelphia, Pa.

WARREN FOUNDRY AND MACHINE CO.,

Established 1836. Works at Phillipsburgh, N. J.

New York Office, 160 Broadway.

CAST IRON WATER AND GAS PIPE,

From Three to Forty-Eight Inches Diameter. Also, all Sizes of

Flange Pipe for Sugar House and Mine Work. Branches, Bends, Retorts, etc., etc.

CORNELL & UNDERHILL,

Wrought & Cast Iron Pipe,

MALLEABLE AND CAST IRON FITTINGS,

Brass and Iron Cocks and Gate Valves,

43, 45 AND 47 BEACH ST., NEW YORK.

"Blow Specials" "Stivelite" "Clamorgan" "Pig Holders"

M. J. DRUMMOND & CO.

MANUFACTURERS OF

CAST IRON

FLANGE

GAS & WATER PIPE

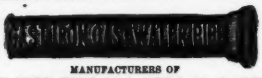
GENERAL SALES OFFICE, 192 BROADWAY, NEW YORK.

Western Office: Monadnock Block, Chicago, Ills.

GEORGE ORMROD, Manst. & Treas., Emaus, Pa.
JOHN DONALDSON, Prest., Betz Bldg., Phila., Pa.

EMAUS PIPE FOUNDRY

DONALDSON IRON COMPANY. EMAUS PA.



MANUFACTURERS OF

CAST IRON PIPE AND SPECIAL CASTINGS

FOR WATER AND GAS.

Also, FLANGE PIPE, LAMP POSTS, Etc.

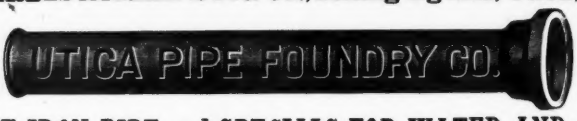
BINDER for the JOURNAL.

Price, $1.00.

A. M. CALLENDER & CO., 32 Pine Street, N.Y.

CHARLES MILLAR & SON CO., Selling Agents, Utica, N.Y.

Flanged Pipe and Fittings, Hydrants, Gates, Pig Lead, Jute, etc.



UTICA PIPE FOUNDRY CO.

Manufacturers of Lead Pipe, Solder, etc., and Jobbers of Plumbers' and Tinners' Goods.

CAST IRON PIPE and SPECIALS FOR WATER AND GAS.

Wholesale Eastern Agents AKRON VITRIFIED SEWER PIPE.

CHRIS. CUNNINGHAM & SON,

PROPRIETORS,

THE NOVELTY STEAM BOILER WORKS,

BROOKLYN, N. Y.

STORAGE TANKS FOR GAS WORKS,

To Retain Fluid Material of Any Sort.

PIPING IN AND AROUND GAS WORKS.

Work Done for Several of the Largest Gas Companies in America Stands as Reference.

(Copyrighted, 1894, by the AMERICAN METER CO.

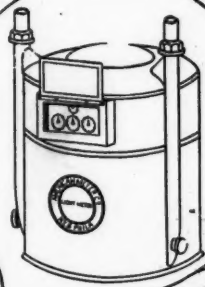
AMERICAN METER CO.

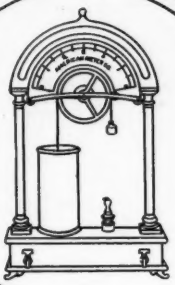
ESTABLISHED 1836. INCORPORATED 1868.

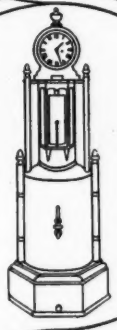
NEW YORK AND PHILADELPHIA,

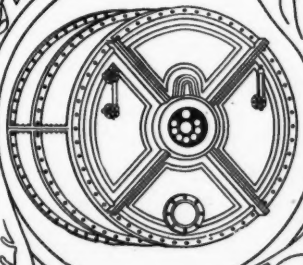
CHICAGO, ST. LOUIS,

SAN FRANCISCO.









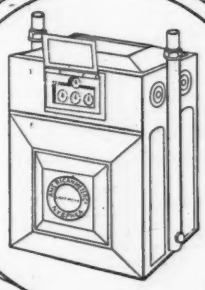
PUBLIC LIGHTING TABLE.

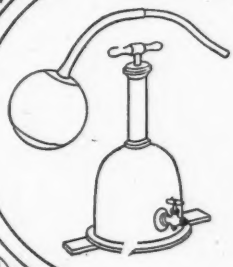
SEPTEMBER, 1900.

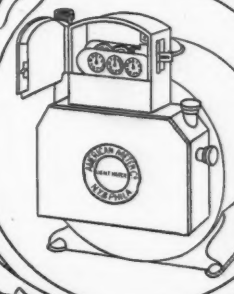
Day of Week.	Date.	Table No. 1. Following the Moon. Light.	Extinguish.	Table No. 2. New York City. All Night Lighting. Light.	Extinguish.
				P.M.	A.M.
Sat.	1	9.20 PM	4.20 AM	6.30	4.20
Sun.	2	10.10	4.30	6.30	4.20
Mon.	3	11.10	4.30	6.15	4.30
Tue.	4	12.10 AM	4.30	6.15	4.30
Wed.	5	1.20	4.30	6.15	4.30
Thu.	6	2.30	4.30	6.15	4.30
Fri.	7	No L.	No L.	6.15	4.30
Sat.	8	No L. FM	No L.	6.15	4.30
Sun.	9	No L.	No L.	6.15	4.30
Mon.	10	6.40 PM	7.50 PM	6.05	4.40
Tue.	11	6.40	8.30	6.05	4.40
Wed.	12	6.40	9.10	6.05	4.40
Thu.	13	6.40	10.00	6.05	4.40
Fri.	14	6.40	10.50	6.05	4.40
Sat.	15	6.40 LQ	11.50	6.05	4.40
Sun.	16	6.30	12.50 AM	6.05	4.40
Mon.	17	6.30	1.50	5.55	4.50
Tue.	18	6.30	2.50	5.55	4.50
Wed.	19	6.30	3.40	5.55	4.50
Thu.	20	6.30	4.50	5.55	4.50
Fri.	21	6.30	4.50	5.55	4.50
Sat.	22	6.30	4.50	5.55	4.50
Sun.	23	6.20 NM	4.50	5.55	4.50
Mon.	24	6.20	4.50	5.40	5.00
Tue.	25	6.20	4.50	5.40	5.00
Wed.	26	6.20	4.50	5.40	5.00
Thu.	27	6.20	4.50	5.40	5.00
Fri.	28	7.20	4.50	5.40	5.00
Sat.	29	8.00	4.50	5.40	5.00
Sun.	30	9 00	5.00	5.40	5.00

TOTAL HOURS LIGHTING DURING 1900.

By Table No. 1.	Hrs.Min.	By Table No. 2.	Hrs.Min.
January	230.50	January	423.20
February	175.40	February	355.25
March	189.00	March	355.35
April	160.30	April	298.50
May	150.40	May	264.50
June	137.00	June	234.25
July	152.00	July	243.45
August	171.50	August	280.25
September	187.20	September	321.15
October	213.10	October	374.30
November	221.50	November	401.40
December	231.50	December	433.45
Total, yr.	2221.40	Total, yr.	3987.45







NEW YORK, 33 Nassau St. PHILADELPHIA, Broad and Arch Sts. CHICAGO, 54 Lake St.

Welsbach Street Lighting Company

.... OF AMERICA ....

No. 36.

Controls and Operates the

Welsbach System of Street Lighting,

Which includes its specially DESIGNED AND PATENTED BURNER for STREET and PARK LIGHTING exclusively.

Uniformly SUCCESSFUL in seventy-five Cities and Towns.

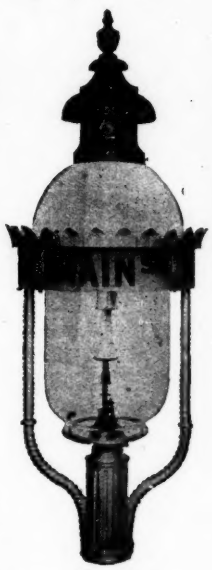
By means of the Welsbach System of street lighting the superiority of GAS over electricity for street lighting has been fully demonstrated.

POINTS OF MERIT:

It is { Economical, Attractive, Successful, Up-to-date.

IT LIGHTS THE STREET.

Where there are no gas mains we can furnish an equally good light by our SELF-GENERATING NAPHTHA WELSBACH BURNER, and thereby supply a uniform light in all localities.



No. 38.

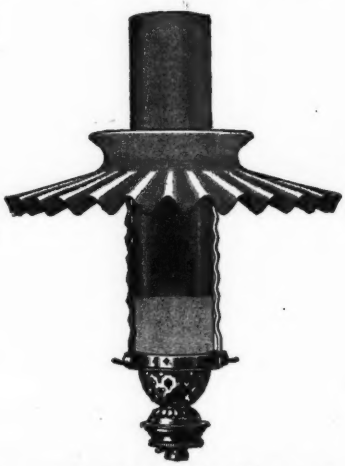
Correspondence solicited from Gas Companies and others interested in Municipal and outside lighting.

Welsbach Famous Mantles.

THE INCOMPARABLE

"Yusea" Welsbach Mantle

FINEST EXAMPLE OF INCANDESCENT GAS LIGHT EVER EXHIBITED.



OTHER WELSBACH BRANDS —OF— Magnificent Brilliancy —AND— Endurance.

THE HIGHEST ILLUMINATION, The Lowest Cost.

Welsbach Lamps, Mantles, and Complete Line of Glassware and Supplies

WELSBACH COMPANY,

GLOUCESTER, N. J.

Chicago Branch Department and Supply House, - - - - - 70 Wabash Avenue.

THE UNITED GAS IMPROVEMENT COMPANY.

THE STANDARD DOUBLE SUPERHEATER LOWE WATER GAS APPARATUS.

CONTRACTS RECEIVEED SINCE JANUARY 1, 1900.

	SETS.		SETS.
DANSVILLE, N. Y.	1	CARBONDALE, PA.	1
WEST CHESTER, PA.	1	HACKENSACK, N. J.	1
COHOES, N. Y.	2	TIFFIN, O.	1
OGDEN GAS CO., CHICAGO	1	MOUNT HOLLY, N. J.	1
CENTRAL UNION GAS CO., NEW YORK	1	SEATTLE, WASH.	1
SPENCER, MASS.	1	TARRYTOWN, N. Y.	1
SAN FRANCISCO	1	HOBOKEN, N. J.	2
BROOKLYN UNION GAS CO., BROOKLYN	1	PATERSON, N. J.	2
RICHMOND, VA.	2	NEWARK, N. J.	2
CAMBRIDGE, MASS.	2	JERSEY CITY, N. J.	1

NUMBER OF SETS 26
TOTAL SETS INSTALLED TO JANUARY 1, 1900 327

TOTAL SETS INSTALLED TO DATE 353
TOTAL DAILY CAPACITY . . . . . 226,600,000 Cubic Feet.

The United Gas Improvement Company,

Broad and Arch Streets, Philadelphia.

Established 1858. Incorporated 1890.
CHAS. E. GREGORY Prest. DAVID R. DALY V. Prest. & Treas.
H. D. ABERNETHY, Sec.

J. H. Gautier & Co.

Greene & Essex Streets,
Jersey City, N. J.

MANUFACTURERS OF

CLAY GAS RETORTS, FIRE CLAY TILES,
FIRE BRICK and FIRE CLAY SPECIALTIES.

Ground Fire Clay, Fire Sand and Ground Fire Brick in Barrels and Bulk.

SOLE MANUFACTURERS OF THE

FLEMMING GENERATOR GAS FURNACE

E. D. WHITE, President. A. H. GUTKES, Vice-President. H. A. PERKINS, Secretary.

Brooklyn Fire Brick Works,

MANUFACTURERS OF

CLAY RETORTS, FIRE BRICK,
Gas House and other Tile.

Office, 88 Van Dyke St. Brooklyn, N. Y.

Established 1854. Incorporated 1869.

LACLEDE
Fire Brick Manufg. Co.,

Manufacturers of { GAS RETORTS . .
FIRE BRICK . . .
RETORT SETTINGS

Water Gas Cupola Linings, Fire Clay, Etc.

Proprietors for the U. S., Coze System of Inclined Benches.

Estimates Furnished on Application for Most Successful Style of Construction.

Also for Free-Firing and Full and Half-Depth Regenerative Benches, for Burning either Coal or Coke in the Furnaces.

Office: 914, 915 & 916 Wainwright Building, St. Louis, Mo.

The Construction of Gas Works

PRACTICALLY DESCRIBED,

By WALTER RALPH HERRING.

Price $2. For Sale by

A. M. CALLENDER & CO.,

32 Pine Street, N. Y. City.

Adam Weber,

Proprietor,

Manhattan Fire Brick and Enameled Clay Retort Works.

Works, Weber, N. J.

Office, 633 East 15th St., New York.

Modern Recuperative Furnaces

And Standard Fire Brick and Gas Retorts.

Works. LOCKPORT STATION, PA.

—ESTABLISHED 1864.—

JAMES GARDNER, JR., CO.,

Hamilton Building, Fifth Avenue, PITTSBURGH, PA. P. O. Box 373.

Successor to WILLIAM GARDNER & SON,

Fire Clay Goods for Gas Works.

SOLE REPRESENTATIVE OF THE McILHENNY REGENERATIVE BENCHES FOR THE U. S.

HENRY MAURER & SON,

(ESTABLISHED 1856.)

EXCELSIOR FIRE BRICK & CLAY

RETORT WORKS

WORKS, Perth Amboy, N. J.

OFFICE, 418 to 422 East 23d St., N. Y.

Clay Gas Retorts,

BENCH SETTINGS,

Fire Brick, Tiles, Etc.

GEROULD'S IMPROVED RETORT CEMENT

A Cement of great value for patching retorts, putting on mouthpieces, making up all bench-work joints, lining blast furnaces and cupolas. This cement is mixed ready for use. Economic and thorough in its work. Fully warranted to stick.

Price List, f.o.b. Galesburg or Brooklyn.

In Casks, 400 to 800 pounds, at 5 cents per pound.
In Kegs, 100 to 300 " " 6 " "
In Kegs less than 100 " " 7 " "

C. L. GEROULD, Galesburg, Ills.

Eastern Agent, GEO. P. WARRINER, 675 Bedford Ave., BROOKLYN, N. Y.

Parker-Russell Mining and Mfg. Co.,

CITY OFFICE,

417 Pine Street, St. Louis, Mo.

PROPRIETORS OF THE

OAKHILL GAS RETORT & FIRE BRICK W'KS

Our immense establishment is now employed almost entirely in the manufacture of

Materials for Gas Companies

We have studied and perfected three important points. Our retorts are made to stand changes of temperature, the strongest heats of the furnace, and the abrasion of feeding and emptying. We construct

Half and Full Depth Benches of Our Own Design,

Containing 6, 8 or 9 Retorts.

We have Greatly Improved our Recuperators. Coal or Coke can be used as Fuel in Furnaces.

THEO. J. SMITH, Prest. J. A. TAYLOR, Sec.
A. LAMBLA, Vice-Prest. and Supt.

BALTIMORE RETORT & FIRE BRICK CO.

MANUFACTORY AT

LOCUST POINT BALTIMORE MD.

Clay Retorts, Blocks & Tiles

FIRE BRICK, FIRE CLAY,
AND FIRE CEMENT.

Red and Buff Ornamental Tiles and Chimney Tops. Baker Oven Tiles 12 x 12 x 2 and 10 x 10 x 2.

WALDO BROS., 103 MILK ST., BOSTON, MASS.

Sole Agents for New England States.

JOHN DELL, General Manager.

MISSOURI FIRE BRICK CO.,

ESTABLISHED 1882.

MANUFACTURERS OF

Gas Retorts, Bench Settings, Fire Brick, Cupola Linings, Etc.

We are prepared to furnish and erect COMPLETE, Half and Full Depth Benches of 6's, 8's, 9's, with Regenerative Furnaces, Constructed to Burn either Coal or Coke. Also Plain Benches.

CORRESPONDENCE IS RESPECTFULLY SOLICITED.

{ CITY OFFICE: 411 Olive St., Continental Bank, } ST. LOUIS, MO.

National Gas and Water Company.

CONTRACTORS FOR
Gas Plant Machinery

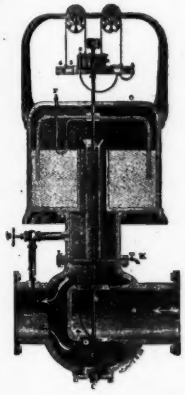
SOFT COAL OR COKE
WATER GAS GENERATORS
A SPECIALTY.

218 LA SALLE ST.,
CHICAGO.

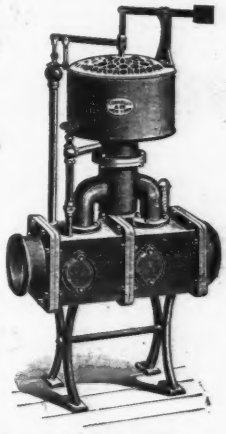
Gas Engineers
INSPECTION AND ADVICE.

PLANS AND ESTIMATES
FOR IMPROVEMENTS OR
REPAIRS.

GAS WORKS SPECIALTIES,



AUTOMATIC STREET GAS GOVERNORS,
BALANCE GAS GOVERNORS.
"Iron Sponge" and Natural Oxide
FOR GAS PURIFICATION.
EXHAUSTERS, ETC.



Connelly Iron Sponge & Governor Co.

No. 357 CANAL STREET,
NEW YORK CITY.

WESTERN BRANCH CONNELLY IRON SPONGE & GOVERNOR CO.,
788 South Canal Street, Chicago, Ills.

Hughes'
"Gas Works,"

Their Construction and Arrangement,

And the Manufacture and Distribution of Coal Gas.

Originally written by SAM'L HUGHES, C.E.

Rewritten and Much Enlarged by
WM. RICHARDS, C.E.

Eighth Edition, Revised, with Notices of Recent Improvements.

Price, $1.65.

A. M. CALLENDER & CO.,
32 Pine St., N. Y. City.

Parson's Steam Blower

FOR IMPROVING BAD DRAUGHT IN BOILERS, AND FOR BURNING BREEZE OR OTHER WASTE MATERIAL.

PARSON'S TAR BURNER,

FOR USING COAL TAR AS FUEL.

PARSON'S AIR JET TUBE CLEANER,

FOR CLEANING BOILER TUBES.

These devices are all first-class. They will be sent to any responsible party *for trial*. No sale unless satisfactory. Manufactured by the WATERTOWN STEAM BLOWER COMPANY.

H. E. PARSON, Supt., 457 Putnam Ave., Brooklyn, N. Y.

The Chemistry of Illuminating Gas,

By NORTON H. HUMPHRYS. Price, $2.40.

A. M. CALLENDER & CO., 32 PINE ST., N. Y. CITY.

The Gas Engineer's Laboratory Handbook,

By JOHN HORNBY, F.I.C.

Price, $2.50.

A. M. CALLENDER & CO., 32 Pine Street N Y. City

Practical Hints on the Construction and Working of Regenerator Furnaces,

By MAURICE GRAHAM, Assoc M.Inst.C.E.

Price, $1.25. For Sale by

A. M. CALLENDER & CO., No. 32 Pine Street, New York City.

JAMES D. PERKINS, President. F. SEAVERNS, Treasurer.

THE PERKINS COMPANY,

228 and 229 Produce Exchange, New York City.

TIDEWATER SALES AGENTS FOR THE FOLLOWING:

Ocean Mine Youghiogheny Gas Coal,
Old Kentucky Shale and O. K. Boghead.

SHIPMENTS FROM NEW YORK, PHILADELPHIA, BALTIMORE AND NORFOLK.

BERWIND-WHITE COAL MINING COMPANY'S

Ocean Westmoreland Gas Coal.

Offices:
Washington Building, New York.
Betz Building, Philadelphia.

STRICTLY High Grade. . . . .
Carefully prepared.
For Gas Making or
Heavy Steaming.

SCIENTIFIC BOOKS.

GAS MANUFACTURE, THE CHEMISTRY OF, by W. J. A. Butterfield. $3.50.

NEWBIGGING'S HANDBOOK. By Thos. Newbigging. 6th edition. $6.

COX'S GAS FLOW COMPUTER. $2.50.

FIELD'S ANALYSIS, 1898. $5.

HUGHES' GAS WORKS. $1.65.

POOLE ON FUELS. By Herman Poole. $3.

GAS ENGINEER'S POCKET-BOOK. By Henry O'Connor. $3.50.

TECHNICAL GAS ANALYSIS. $3.

GAS CONSUMER'S HANDYBOOK, by Wm. Richards. 20 cents.

CHEMISTRY OF ILLUMINATING GAS. By Norton H. Humphrys. $2.40.

PRACTICAL TREATISE ON HEAT By Thomas Box. 2d edition. $5.

PRACTICAL PHOTOMETRY: A Guide to the Study of the Measurement of Light. By W. J. Dibdin. $3.

CHEMICAL TECHNOLOGY: Vol. I., *Fuel and Its Applications*, $5. Vol. II., *Lighting*, $4.

IRONWORK: Practical Designing of Structural Ironwork. By H. Adams. $3.50.

HEMPEL'S GAS ANALYSIS, $3.

LIQUID FUEL FOR MECHANICAL AND INDUSTRIAL PURPOSES. By E. A. Brayley Hodgetts. $2.50.

COAL: Its History and Use. By Prof. Thorpe. $3.50.

PRACTICAL HANDBOOK ON GAS ENGINES, by G. Lieckfield. $1.

HEAT A MODE OF MOTION. By John Tyndall. $2.50.

THEORY OF HEAT. By J. Clerk-Maxwell. $1.50.

MANUAL FOR GAS ENGINEERING STUDENTS. By D. Lee. 40 cents.

GASFITTER'S GUIDE, by John Eldridge 40 cents.

AMMONIA AND AMMONIUM COMPOUNDS. By Dr. R. Arnold. $2

CONSTRUCTION OF GAS WORKS, by Walter Ralph Herring. $2.

DIGEST OF GAS CASES. $5.

PRACTICAL HINTS ON REGENERATOR FURNACES By M. Graham. $1.25.

A TREATISE ON THE COMPARATIVE COMMERCIAL VALUES OF GAS COALS AND CANNELS. By D. A. Graham. $3.

A TEXT BOOK OF INORGANIC CHEMISTRY. By Prof. Victor Von Richter. $2.

ILLUMINATING AND HEATING GAS. By W. Burns. $1.50

HANDBOOK FOR MECHANICAL ENGINEERS. By H. Adams. $2.50.

TREATISE ON MASONRY CONSTRUCTION. Baker. $5

GAS ENGINEER'S LABORATORY HANDBOOK. By Jno. Hornby. $2.50.

GAS LIGHTING AND GAS FITTING. By W. P. Gerhard. 50 cents.

PRACTICAL PLUMBING. By P. J. Davies. $3.

AMERICAN PLUMBING. By Alfred Revill. $3.

CEMENT; A Manual of Lime and Cement, their Treatment and Use in Construction. By A. H. Heath. $2.50.

A COMPARISON BETWEEN THE ENGLISH AND FRENCH METHODS OF ASCERTAINING THE ILLUMINATING POWER OF COAL GAS. $1.00.

ELECTRICITY.

INDUSTRIAL PHOTOMETRY, with Special Application to Electric Lighting. By A. Palaz, Sc.D. $4.

ELEMENTS OF ELECTRIC LIGHTING, Including Electric Generation, Measurement, Storage and Distribution. By Philip Atkinson. $1.50.

ELECTRIC TRANSMISSION OF ENERGY. By G. Kapp. $3.50.

ELECTRICIAN'S POCKETBOOK. By Monroe and Jamieson. $3.50.

DYNAMO BUILDING. By F. W. Walker. 50 cents.

DOMESTIC ELECTRICITY FOR AMATEURS. By E. Hospitalier. $2.50.

PRACTICAL MANAGEMENT OF DYNAMOS AND MOTORS. $1.

PRACTICAL GUIDE TO THE TESTING OF INSULATED WIRES AND CABLES. $1.

ELECTRIC LIGHTING, by Francis B. Crocker. $3.

ELECTRIC LIGHT FITTING. $2.

PRACTICAL ELECTRICITY. $2.50.

ELECTRICITY FOR ENGINEERS. $2.50.

ELECTRICITY, Its Theory, Sources and Applications. By John T. Sprague. $6.

The above will be forwarded upon receipt of price. If sent by mail or express, postage or express charges must be added to above prices. We take especial pains in securing and forwarding any other Works that may be desired, upon receipt of order. All remittances should be made by check, draft, or post office money order. No books sent C.O.D.

A. M. CALLENDER & CO., 32 Pine Street, New York.

The Despard Gas Coal Co.,

MINERS AND SHIPPERS OF

DESPARD GAS COAL,

AND MANUFACTURERS OF

COKE.

MINES, - - Clarksburgh, Harrison Co., West Va.
WHARVES, - - - Locust Point Baltimore, Md.
OFFICE, - 640 Equitable Building Baltimore, Md.

ROUSSEL & HICKS, 71 Broadway, N. Y. } AGENTS, { BANGS & HORTON 60 Congress St., Boston.

KELLER ADJUSTABLE COKE CRUSHER.

Strong, Simple, Durable. Will Crush any Size Desired.

C. M. KELLER,
Sec. & Supt. Gas Lt. & Coke Co.,
Columbus, Ind.
Correspondence Solicited.

Do You Wish to Know

what size of pipe to use to convey any quantity of gas, any distance, with any loss of pressure and any initial or final pressure? Then use

Cox's Gas Flow Computer,

as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

Price, 6.5 x 8 inches, in cloth case, $2.50. For sale by

A. M. Callender & Co., 32 Pine St., N. Y.

GREENOUGH'S 'DIGEST OF GAS CASES."

Price, $5.00.

This is a valuable and important work, a copy of which should be in the possession of every gas company in the country, whether large or small. As a book of reference it will be found invaluable. It is the only work of the kind which has ever been published in this country, and is most complete. Handsomely bound. Orders may be sent to

A. M. CALLENDER & CO., 32 Pine St., N. Y.

MADEIRA, HILL & CO.,

INCORPORATED.

MINERS AND SHIPPERS

Anthracite and Bituminous Coal and Coke.

GENERAL EASTERN SALES AGENTS

PENN GAS COAL CO.

OPERATING THE FAMOUS MINES IN THE

YOUGHIOGHENY COAL BASIN.

OWNERS OF OVER 1,000 COAL CARS.

COAL CAREFULLY SCREENED AND PREPARED FOR GAS PURPOSES.

OFFICES:

PHILADELPHIA, 32 South Broad Street. BOSTON, 70 Kilby Street. NEW YORK, 143 Liberty Street.
BRIDGEPORT, CONN. READING, PA.

EDMUND H. McCULLOUGH, Prest. CHAS. F. GODSHALL, Treas. H. C. ADAMS, Sec.

THE WESTMORELAND COAL CO.

Chartered 1854.

Mines situated on the Pennsylvania and the Baltimore and Ohio Railroads, in Westmoreland County, Pa.

POINTS OF SHIPMENT:

PHILADELPHIA, BALTIMORE, SOUTH AMBOY, N. J., WATKINS (SENECA LAKE), N. Y.

Since the commencement of operations by this Company its well-known Coal has been largely used by the Gas Companies of New England and the Middle States, and its character is established as having no superior in gas-giving qualities, and in freedom from sulphur and other impurities.

Principal Office, 224 South 3d St., Phila., Pa.

THE SUN OIL CO.,

Crude Oil, Gas Naphtha,
Refined Petroleum, Gas Oil.

Toledo, O., and Pittsburgh, Pa.

Standard Oil Company,

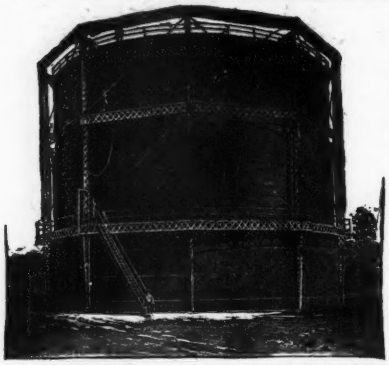
GAS NAPTHA DEPARTMENT.

GAS NAPTHA.

GAS OIL.

Correspondence Solicited.

26 Broadway, New York City.



DAVIS & FARNUM MFG. CO.,
WALTHAM, MASS.

Principal Office & Works, Waltham, Mass. Boston Office, R'm 18, Vulcan Bldg., 8 Oliver St.

Single, Double and Triple-Lift Gasholders of any Capacity. Tubular, Pipe and Sinuous Friction Condensers of all Sizes.

Steel Tanks for Gasholders, Iron Roof Frames and Floors Purifying Boxes, Center Seal or Valve Connections, Bench Work, Reversible Lime Trays.

Self-Sealing and Pressed Steel Mouthpiece Lids.

Coke Borrows, Coal Wagons, and all Apparatus Requisite for a Complete Gas Works.

Also, Gas and Water Pipe, Flanged Pipe, Sugar House Work, and Special Castings of all Descriptions.

BAXTER & YOUNG,
CONTRACTING AND CONSULTING GAS ENGINEERS.

Examination and Values Ascertained of Artificial and Natural Gas Properties.

COMPLETE GAS WORKS ERECTED.

Artificial and Natural Gas Mains Furnished and Laid.

CORRESPONDENCE SOLICITED.

OFFICE: WAYNE COUNTY BANK BUILDING, Rooms 201 & 202. DETROIT, MICH.

A. E. BOARDMAN, C. E.,
Consulting and Contracting Engineer.

Particular attention given to Gas, Water and Electric Plants. Long and successful experience with the problem and practice of

Filtration for Public Water Supply.

BREVARD, N. C.

Geo. Shepard Page's Sons.
GAS MACHINERY.

Correspondence Solicited.

180 Fulton Street, New York City.

JAMES T. LYNN,
GAS ENGINEER AND CONTRACTOR,

Wayne Bank Building, - DETROIT.

GAS PROPERTIES PURCHASED.

DAVID LEAVITT HOUGH,
Consulting Engineer AND CONTRACTOR,

374 FIFTH AVE., N. Y.

Kerr Murray Manufacturing Company,
Steel Gasholder Tanks,
SINGLE, DOUBLE AND TRIPLE-LIFT GASHOLDERS,
HORIZONTAL AND VERTICAL STORAGE OIL TANKS

Iron Work for Coal Gas Benches, Self-Sealing Mouthpieces, Exhausters, Condensers, Scrubbers, Purifiers, Wooden Trays, Floor Carriages, Center Seal and Valve System Connections, Cast and Wrought Iron Fittings, and Connections 3 to 36 Inches Diameter.

VALVES, Double Gate, Hub and Flange, Outside Screw and Quick Opening, 3 to 36 In. Diam.

COAL AND COKE WAGONS, RETORT HOUSE TOOLS, STREET MAIN SPECIALS AND DRIPS.

Address.

KERR MURRAY MANUFACTURING CO.
Fort Wayne, Indiana.

BARTLETT, HAYWARD & CO.

BALTIMORE, MD.

Triple, Double and Single-Lift Gasholders.

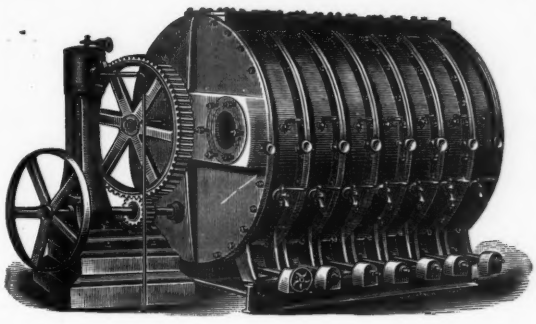
Iron Holder Tanks.

ROOF FRAMES.

Girders.

BEAMS

PURIFIERS.



CONDENSERS.

Scrubbers.

Bench Castings.

OIL STORAGE TANKS

Boilers.

PATENT STANDARD WASHER-SCRUBBER.

The best apparatus for the extraction of all Ammonia and a large proportion of Carbonic Acid and Sulphureted Hydrogen. The Scrubber has been materially improved and is provided with patented Wooden Segmental Grids, instead of Metallic Discs, thus reducing the weight on shaft and power for operating same

The Wilkinson Water Gas Process.

THIRTY-CANDLE, NON-CONDENSABLE, FIXED GAS. THE MOST SUCCESSFUL GAS PROCESS IN OPERATION.

MILL'S REVERSIBLE LIME TRAYS.

Gas Works Designed and Constructed.

ALEX. C. HUMPHREYS, M.E., M. Inst. C.E. ARTHUR G. GLASGOW, M.E., M. Inst. C.E.

HUMPHREYS & GLASGOW,

BANK OF COMMERCE BLDG., 31 Nassau Street, New York.

9 VICTORIA STREET, London S.W., England.

CONSULTING GAS ENGINEERS AND MANAGERS.

GAS PROPERTIES PURCHASED.

GASHOLDER TANKS AND GAS WORKS MASONRY COMPLETE

Plans prepared and Estimates furnished at short notice.

J. P. WHITTIER,

238 Java Street, Brooklyn, N. Y.

GEORGE R. ROWLAND.

Formerly with the Continental Iron Works.

Draughtsman and Constructing Engineer.

Drawings, Specifications and Estimates furnished for the construction of new works or alteration of old works. Special attention given to Patent Office drawings.

Office, No. 245 Broadway, N. Y. City.

Foundries and Works: { Millville, N. J. / Florence, " / Camden, "

R. D. WOOD & CO.

ENGINEERS, IRON FOUNDERS, MACHINISTS

400 Chestnut Street, PHILADELPHIA, PA.

MANUFACTURERS OF

Cast Iron Pipe.

SOLE MAKERS OF

THE MITCHELL SCRUBBER

(PATENTED.)

PURIFIERS, CONDENSERS, SCRUBBERS, BENCH WORK.

BUILDERS OF

Gas Holders.

Single, Double and Triple Lifts, with or without Wrought Iron or Steel Tanks.

CUTLER'S PATENT FREEZING PREVENTER For Gas Holder Cups.

THE TAYLOR REVOLVING BOTTOM GAS PRODUCER.

HEAVY LOAM CASTINGS, DUNHAM SPECIALS, HYDRAULIC WORK, LAMP POSTS, VALVES, Etc.

ISBELL-PORTER CO.,

ENGINEERS AND CONTRACTORS FOR THE

Construction and Extension of Gas Works.

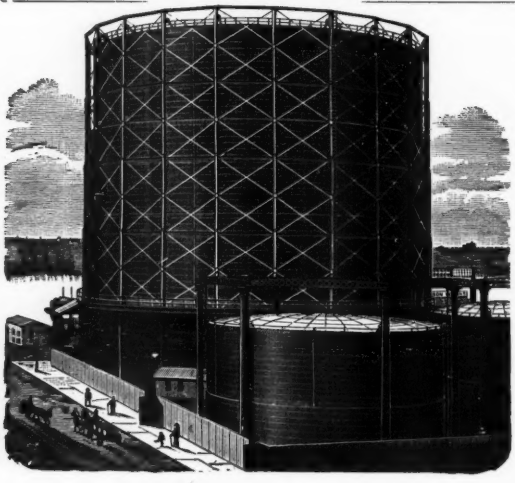
FOUNDERS AND MACHINISTS.

MANUFACTURERS OF

All Ironwork and Machinery Required in a Gas Plant.

Estimates, Drawings and Specifications furnished for the Alteration, Improvement, or Extension of Existing Works or the Construction of New Works.

245 Broadway, New York City. —OFFICES— Bridge & Ogden Sts., Newark, N. J.



The Continental Iron Works,

THOMAS F. ROWLAND, President.
WARREN E. HILL and CHAS. H. CORBETT, Vice-Presidents.
THOMAS F. ROWLAND, Jr., Secretary & Treasurer.

West and Calyer Sts. (Near 10th & 23d St. Ferries)
NEW YORK, Borough of Brooklyn.

BUILDERS OF

Gas Holders.

Single and Multiple Section Gas Holders a Specialty.

STEEL GAS HOLDER TANKS.

BENCH CASTINGS, RETORT LIDS.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, Etc.

Self-Sealing Retort Mouthpieces & Lids

For Round, Oval, or "D" Retorts.

ILLUMINATING GAS! FUEL GAS!

THE LOOMIS PROCESS.

Now in successful operation at Works of John Russell Cutlery Co., Turner's Falls, Mass., and Henry Disston's Son's Saw Works, Tacony, Pa.

The Cheapest Gas Generating System in the World.

Plans and Estimates Furnished.

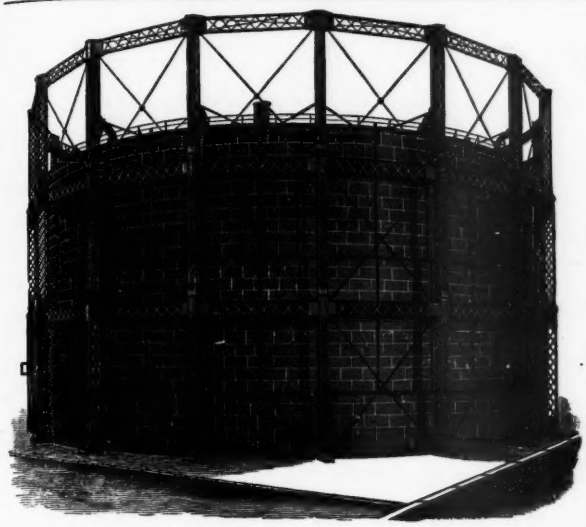
BURDETT LOOMIS, - - Hartford, Conn.

To Gas Companies.

We make to order CAP BURNERS to burn any amount under a stated pressure. Send for samples.

Also SERVICE CLEANERS, DRIP PUMPS, and STREET MAIN PROVING APPARATUS.

C. A. GEFRORER,
248 N. 8th St., Phila., Pa.



WILLIAM STACEY, Prest. T. H. BIRCH, Asst. Mangr.
J. E. STACEY, Vice-Prest. & Gen. Mangr. R. J. TARVIN, Sec. & Treas.

THE STACEY MANUFACTURING CO.

Established 1851.

Single, Double and Triple-Lift

GASHOLDERS,

Of any Capacity, with or without Wrought Iron or Steel Tanks.

Hydraulic Mains, Condensers, Scrubbers, Purifiers, Valves, etc.

Coal Gas Benches, Roof Frames,

OIL STORAGE TANKS.

Pressed Steel Mouthpiece Lids, Self-Sealing Mouthpiece Lids.

General Office: Cincinnati, O.
Eastern Office: 911 Drexel Building, Philadelphia, Pa.

RITER-CONLEY MFG. CO.,

GASHOLDERS, with or without Steel Tanks.

Purifiers, Condensers, Scrubbers, Oil Tanks, Smoke Stacks.

STEEL ROOFS and BUILDINGS.

PLATE AND STRUCTURAL WORK OF EVERY DESCRIPTION.

GENERAL OFFICE: Pittsburg, Pa. EASTERN OFFICE: 39-41 Cortlandt St., New York City.

WM. HENRY WHITE,

No. 32 Pine Street, - - - New York City.

ENGINEER AND CONTRACTOR FOR THE

ERECTION AND EXTENSION OF

GAS, WATER, AND ELECTRIC LIGHT WORKS.

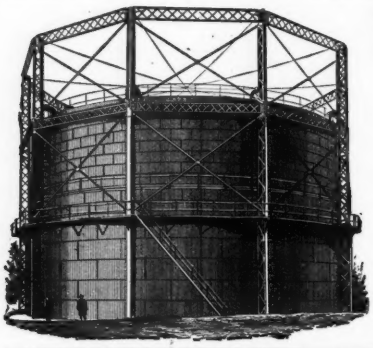
Correspondence with Gas Companies contemplating extending or improving their Plants respectfully invited.
Plans and Estimates Furnished.

1900 DIRECTORY 1900

OF AMERICAN GAS COMPANIES.

Price, - - - - - - - - - $5.00.

A. M. CALLENDER & CO., - - No. 32 Pine Street, New York.



1842 ✻ Deily & Fowler, ✻ 1900

LAUREL IRON WORKS.

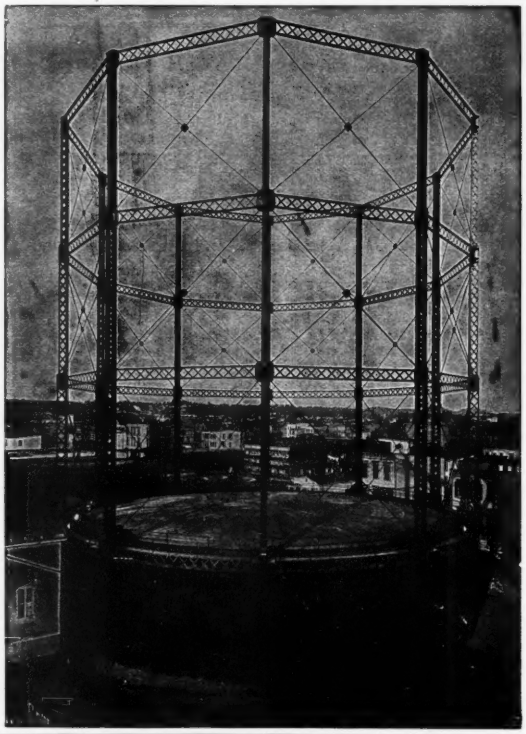
Office, No. 39 Laurel Street, Philadelphia, Pa.

BUILDERS OF

Gasholders

Single or Telescopic. With or Without Iron or Steel Tanks.

OIL TANKS, WATER TANKS, AND GENERAL WROUGHT IRON WORK.



The order for this Triple-Lift Holder and Steel Tank was received by the Logan Iron Works from the Union Gas Light Company, of East New York. The contract was completed and the Holder was in actual use in 90 days from receipt of order. Capacity of Holder, 500,000 Cu.Ft.

LOGAN IRON WORKS,

Brooklyn, N. Y.

MANUFACTURERS OF

Single or Multiple-Lift

GASHOLDERS,

Complete with Steel Tanks.

BENCHES, SCRUBBERS,
CONDENSERS,
PURIFIERS, IRON ROOFS,
Self-Sealing Retort Lids,
AND ALL PARTS OF
GAS WORKS APPARATUS.

Contractors for
Complete Works.

ALSO, SOLE MANUFACTURERS OF

C. W. BLODGET'S
HOT GAS SCRUBBER.

FIELD'S ANALYSIS

For the Year 1899.

An Analysis of the Principal Gas Undertakings in England, Scotland and Ireland. Being the Thirtieth Year of Publication.

Compiled and Arranged by

JOHN W. FIELD,

Secretary and General Manager of The Gas Light and Coke Co., London.

Price $5. For Sale by

A. M. CALLENDER & CO., - No. 32 Pine Street, N. Y. City.

Established 1854.

D. McDONALD & CO.,

MANUFACTURERS OF

WET AND DRY METERS, STATION METERS AND METER PROVERS.

ALSO MAKERS OF

THE GLOVER PREPAYMENT METER.

The amount of gas delivered for the coin can be instantly and positively changed without removing the meter or replacing any parts.

The gas registered agrees absolutely with the amount purchased by the coin.

WE HAVE MADE AND SOLD IN THE UNITED STATES

OVER 50,000 OF THESE METERS,

ALL OF WHICH ARE GIVING PERFECT SATISFACTION.

Correspondence Solicited.

561 West Forty-seventh Street, NEW YORK. | 51, 53 & 55 Lancaster Street, ALBANY, N. Y. | 34 & 36 West Monroe Street, CHICAGO.

NOW READY.

THE SIXTH (AND CENTENARY) EDITION

— OF THE —

Handbook for Gas Engineers and Managers.

By THOMAS NEWBIGGING, M. Inst. C.E.

This Edition of the "Handbook for Gas Engineers and Managers" is a great improvement on all previous editions. Much of the text has been re-written, in order to keep the work abreast of the constant advances that are being made in the Gas Industry.

PRICE, - - $6.00.

A. M. CALLENDER & CO., - - No. 32 Pine Street, N. Y. City.

PRACTICAL HANDBOOK ON

GAS ENGINES

With Instructions for Care and Working of the Same.

By G. LIECKFELD, C.E.

Translated with Permission of the author by GEO. M. RICHMOND, M.E.

Price, $1.00.

A. M. CALLENDER & CO., 32 Pine Street, New York.

Established 1849. With the best facilities for manufacturing, is enabled to furnish reliable work and answer orders promptly.

NATHANIEL TUFTS METER CO.,

8 Medford Street, Boston, Mass.

MANUFACTURERS OF

DRY GAS METERS.

Station Meters of any Capacity.

Test and Experimental Meters, Pressure Registers, Pressure Gauges.

METER PROVERS, PHOTOMETERS, STREET LANTERNS, ETC., ETC.

Prepayment Gas Meters.

CHARLES E. DICKEY. JAMES B. SMALLWOOD. CHARLES H. DICKEY.

THE MARYLAND METER AND MANUFACTURING CO.

Established 1866.

BALTIMORE, North & Saratoga Sts. **CHICAGO, 107 West Monroe St.**

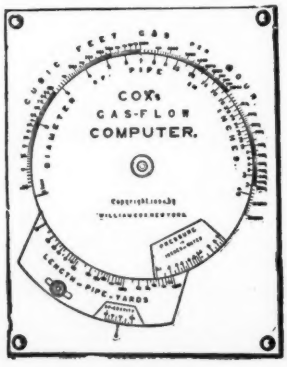
SAN FRANCISCO, 221 Front St.

CONSUMERS' & STATION METERS, PRESSURE GAUGES, Etc., Etc.

"Perfect" Gas Stoves

KEYSTONE METERS, CAREFULLY MADE.

The KEYSTONE METER CO., Royersford, Pa. and WIESTER & CO., 22 Second St., San Francisco.



Do you wish to Know

what size of Pipe to use to convey any quantity of Gas, any distance, with any loss of pressure, and any initial or final pressure? Then use

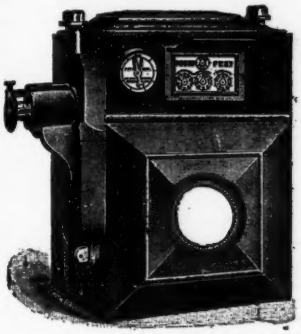
COX'S GAS FLOW COMPUTER,

as it gives this information accurately at sight, without mental effort. No calculations needed. Saves time, money and mistakes.

Price, 6.5 x 8 inches, in cloth case, $2.50.

For sale by

A. M. CALLENDER & CO., 32 Pine St., N. Y. City.



AMERICAN METER COMPANY,

NEW YORK, PHILADELPHIA, SAN FRANCISCO.

PREPAYMENT METERS.

THEIR CONSTRUCTION IS SUCH THAT THEY MAY BE READILY READJUSTED WHEN THE SCALE OF GAS RATES IS CHANGED.

HELME & McILHENNY,

Established 1848. 1339 to 1349 Cherry Street, Philadelphia, Pa.

MANUFACTURERS OF

Wet and Dry Gas Meters, Station Meters, Provers, Gauges, Etc.

METERS REPAIRED

PREPAYMENT GAS METERS.

Our Own Patents. Strong. Simple. PROMPT ATTENTION. CORRESPONDENCE SOLICITED.

METRIC METAL COMPANY,

MAKERS OF

GAS METERS for NATURAL and ARTIFICIAL GAS.

Special Attention given to Repairing METERS of all Makes.

FACTORY AT ERIE, PA.

EXCERPTS FROM DECISIONS

—OF THE—

BOARD OF GAS COMMISSIONERS of the COMMONWEALTH OF MASSACHUSETTS.

MR. E. H. YORKE, NEW HAVEN, CONN., Dec. 1, 1898.

Dear Sir:—I am in receipt of a copy of "Excerpts from the Decisions of the Board of Gas Commissioners," which is a handy compilation in book form of extracts from the most recent decisions of the Gas Commission of Massachusetts.

I note that most of these extracts are broad and safe-guiding precepts, which apply with equal force to one Company as to another. The 13 years' existence of the Board of Gas Commissioners with its unusual opportunities for acquiring information, have justly made it a high and safe authority in all matters pertaining to the management, obligations, and rights of Gas Companies. Your little book will serve as a valuable reference library in settling legal complications which often arise between a Gas Company and its customers.

Yours truly, (Signed) F. C. SHERMAN, Superintendent.

A 28-page Pamphlet containing the cream of this Board's decisions as to the proper management of Gas Companies.

Compiled by E. H. YORKE. Price $1.00. Address

A. M. CALLENDER & CO., - No. 32 Pine Street, N. Y. City.

The advertisement of

THE WESTERN GAS CONSTRUCTION COMPANY, Engineers and Builders,

Improved Double Superheater Lowe Water Gas Apparatus—Manufacturers of General Gas Works Machinery—Builders of Gas Works

WM HENRY WHITE, Eastern Engineer, 32 Pine St., New York.

FORT WAYNE, IND.,

Occupies this space every alternate week.

JOHN J. GRIFFIN & CO.,

1513-1515-1517-1519-1521 Race Street, Philadelphia.

52 Dey Street, New York. WM. S. GRIBBEL, Manager.

75 N. Clinton St., Chicago. FREDERICK WAUGH, Manager.

MANUFACTURERS OF

STATION METERS, CONSUMERS' METERS,

Provers, Registers, Gauges, Experimental Apparatus, Etc.

Prompt Attention Given to All Repairing.

OUR SPECIAL NATURAL GAS METER

Is the Best ever offered. Over 30,000 now in use.

We manufacture in the United States, under the **SAWER & PURVES PATENTS,** the

Positive Prepayment Meter.

. . SIMPLE . .

. DURABLE .

. ACCURATE .

. RELIABLE .

All Parts Interchangeable

This Meter is an unqualified success in Great Britain. Its simplicity of construction, and the positive character of the service performed by it, have given it pre-eminence.

Needs Only the Care Given an Ordinary Meter.
Saves MONEY, TIME and CONSUMERS.
Dispenses with "DEPOSITS" and Increases OUTPUT.